ABUNDANCE, DISTRIBUTION PATTERNS AND HABITAT USE OF HUMPBACK WHALES IN INSHORE WATERS OF THE ISLANDS OF O′AHU, KAUA′I, HAWAI′I AND KAHO′OLAWE (2003)

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INTRODUCTION

For the eighth consecutive year (since 1996), the Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS) sponsored the Sanctuary Ocean Count, an educational event involving volunteers throughout the Hawaiian Islands in the census of humpback whales from shore sites on O′ahu, Hawai′i, Kaua′i and Kaho′olawe. This was only the second year that the island of Kaho′olawe was included in the census thanks to volunteers from the Kaho′olawe Island Reserve Commission. In addition to learning about humpback whales and getting hands on experience in observing them in their natural habitat, volunteers that participate in the Sanctuary Ocean Count contribute important information about humpback whale abundance, distribution, and activity patterns near-shore. The format of the Sanctuary Ocean Count has been evolving significantly from its inception in 1996 and the data collection procedures have been formatted to both be easily understandable by non-scientists and useful to the HIHWNMS staff in providing reasonable estimates of whale abundance and distribution at the selected count sites.

The humpback whale population in the Hawaiian wintering grounds is estimated at 5,000 whales. During their stay in Hawaiian waters (Nov-May), female humpback whales give birth to their calves, and, subsequently, mate. Recent estimates suggest a steady recovery of the Hawaiian humpback whale stock, which is increasing at a rate of approximately 7% per year (Mobley *et al*., 1999; Mobley *et al.,* 2001).

METHODOLOGY

CENSUS DATES AND TIMES

The Sanctuary Ocean Count was conducted on three dates (25 January, 22 February, and 29 March) on the islands of O′ahu, Kaua′i, Hawai′i, and Kaho′olawe. Volunteer Site Leaders counted whales at 15-minute intervals between 0800 and 1215. In addition to this census, separate groups of volunteers monitored whale behavior throughout the morning, and mapped whale positions on a detailed site map between 1030 and 1100.

VOLUNTEER TRAINING

HIHWNMS staff identified two types of volunteers: Site Leaders, and Regular Volunteers. Site Leaders were people willing to participate in training sessions to become able to coordinate, manage and train Regular Volunteers at the shore-based sites assigned to them. Regular Volunteers did not have to undertake any formal training (except on Kauai where both Site Leaders and Regular Volunteers were trained by Sanctuary staff) and, after pre-registering could show up at their chosen shore-based site on the day of the count to assist in data collection and whale observation.

Site Leader training was conducted on 4 January at the Hanauma Bay Education Center on O′ahu; on 5 January on the Hawai′i; and on 11 January on Kaua′i. All Site Leaders were provided with a Site Leader Handbook describing their duties and the data collection procedures.

Trained Site Leaders were instructed to meet Regular Volunteers before 0800 hrs at their shore-based site on the day of the count and to conduct a brief training session on how to collect behavioral information. Site Leaders were instructed to report the preliminary results of the census immediately after the official closing of the event, 1215 hrs, by calling the HIHWNMS staff at the appropriate office. Site Leaders generally remained the same for all count dates (Jan-Mar) on O′ahu and Hawai′i. This was not the case on Kaua′i. Regular Volunteers, generally, changed for each date on all islands.

CENSUS SITES

The 2003 Sanctuary Ocean Count was conducted at 25 sites around the Island of O′ahu (Figure 1), 16 sites on Kaua′i (Figure 2), and 20 sites around Hawai′i (Figure 3) and one site on Kaho′olawe (no map available). Each of these sites was manned by at least one Site Leader.

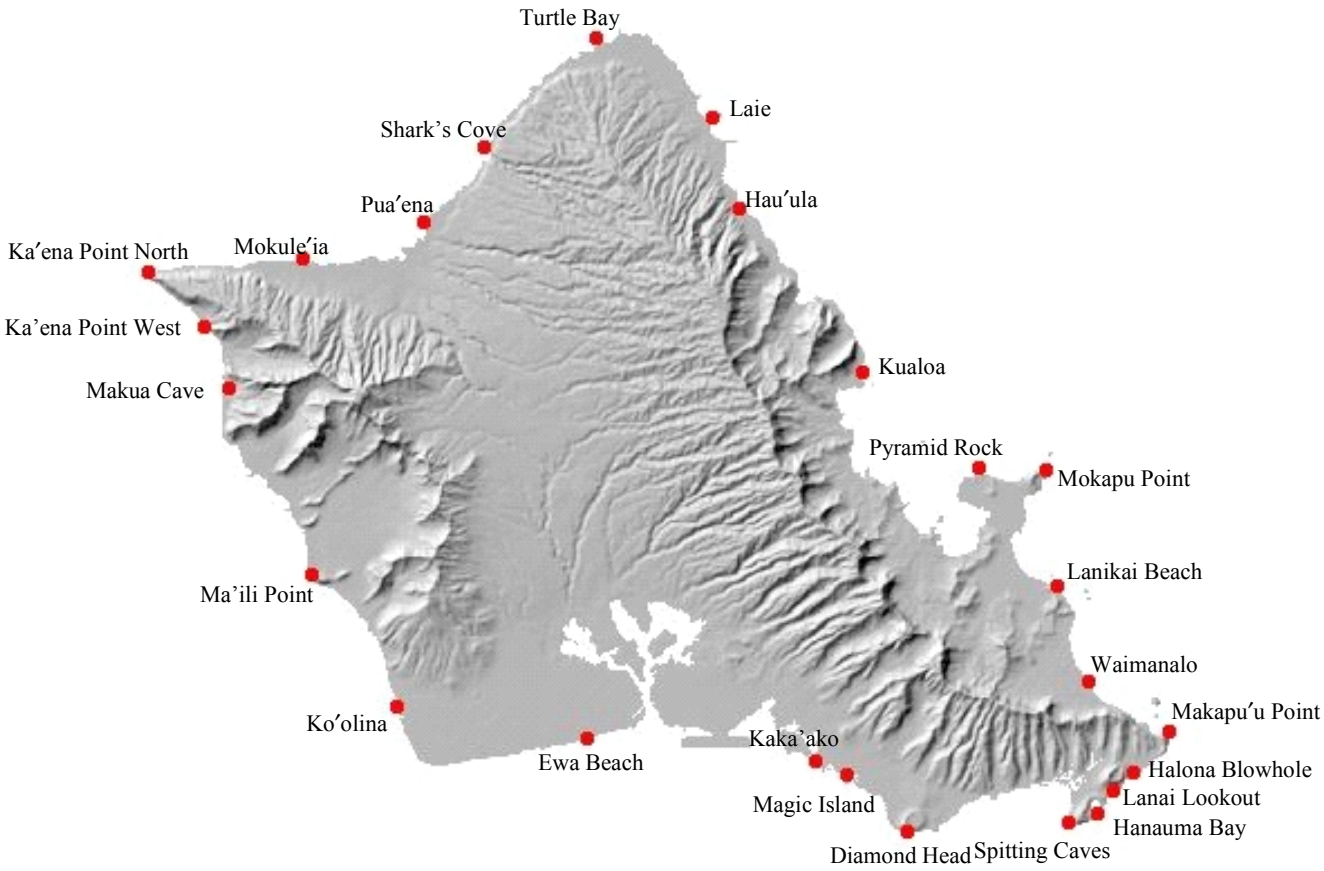


Figure 1 – Sites used on O′ahu

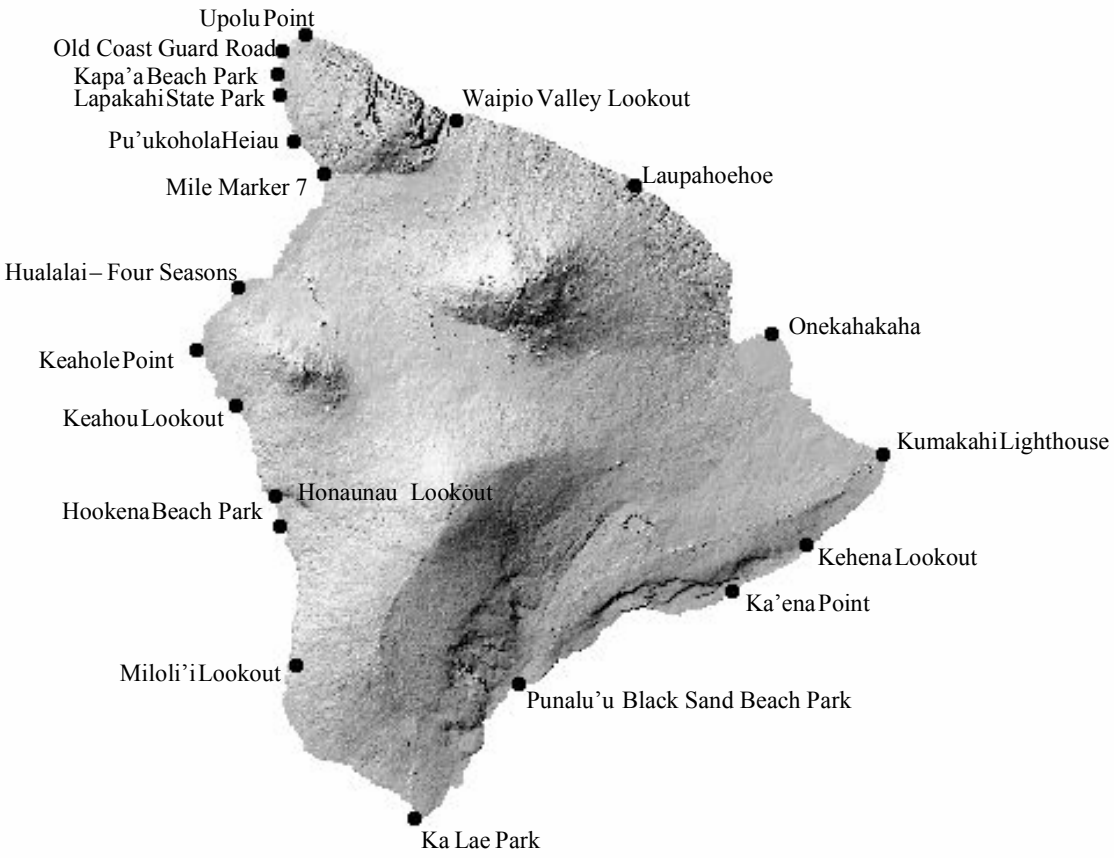


Figure 2 – Sites used on Hawai′i

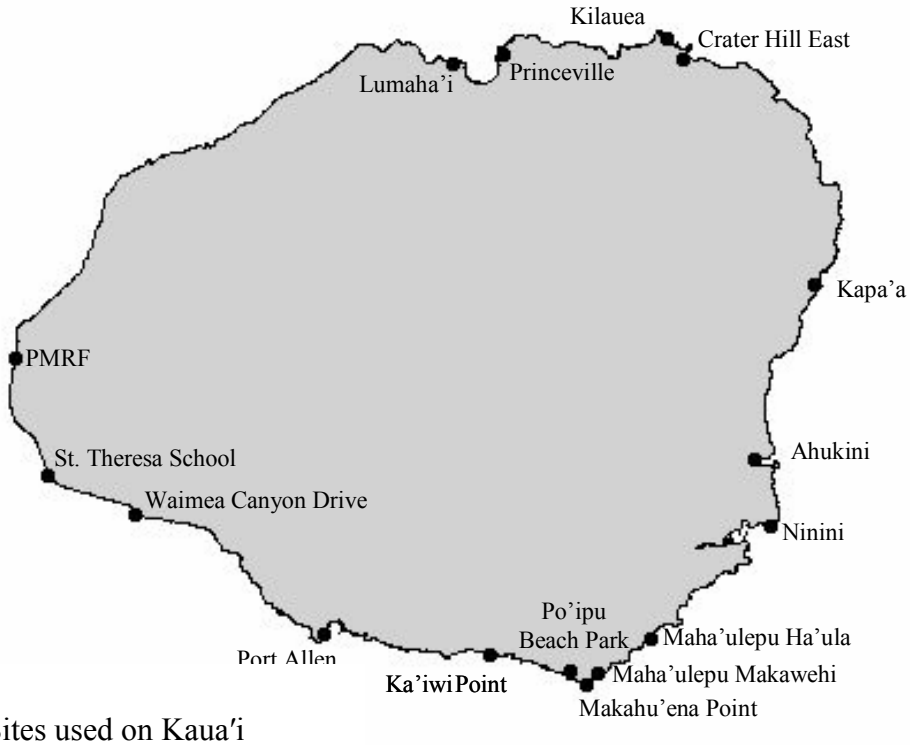


Figure 3 – Sites used on Kaua′i

TYPE OF DATA COLLECTED

This year, three types of data were collected: census data, which were reported on a Census Sheet (Figure 4); behavioral data, which was reported on a Behavior Sheet (Figure 5); and exact whale location data which were reported on a Map Sheet (Figure 6).

CENSUS PROCEDURES

The purpose of the census data was to obtain an estimate of the average number of whales present in coastal waters adjacent to count sites between 0800 and 1215 at three times during the breeding season (January, February, March). By keeping the methodology consistent, these data will be comparable over the years and will give an indication of the trends in population size over long periods of time.

2003 SANCTUARY OCEAN COUNT
CENSUS SHEET (SAMPLE)

Date: _____ Site #: _____ Site Name: _____ Site Elevation: _____

Site Leader: _____ Phone #: _____

Observe area for 15 minutes then tally all observations:

TIME	SPECIES	ADULTS	CALVES	COMMENTS
0800	Humpback Whales	12	4	Whales in three pods
-	Spinner Dolphins	0	n/a	
-	Other Species	0	n/a	Specify species:
-	Other Species		n/a	Specify species:

TIME	SPECIES	ADULTS	CALVES	COMMENTS
0830	Humpback Whales	8	2	Whales in two pods
-	Spinner Dolphins	0	n/a	
-	Other Species	0	n/a	Specify species:
-	Other Species		n/a	Specify species:

TIME	SPECIES	ADULTS	CALVES	COMMENTS
0900	Humpback Whales	12	4	Whales in three pods
-	Spinner Dolphins	15	n/a	
-	Other Species	5	n/a	Specify species: Bottlenose dolphins
-	Other Species		n/a	Specify species:

TIME	SPECIES	ADULTS	CALVES	COMMENTS
0930	Humpback Whales	3	0	May have missed a whale
-	Spinner Dolphins		n/a	
-	Other Species		n/a	Specify species:
-	Other Species		n/a	Specify species:

TIME	SPECIES	ADULTS	CALVES	COMMENTS
1000	Humpback Whales	11	2	One calf was bigger and could have been misidentified
-	Spinner Dolphins		n/a	
-	Other Species		n/a	Specify species:

Figure 4 – Sample Census Sheet used during the 2003 Sanctuary Ocean Count

The census was completed by Site Leaders only, to limit the number of datasheets submitted per site to one (Figure 4), and to ensure that only specially trained personnel participated in this portion of the Sanctuary Ocean Count. Nine times, for a 15-minute period (0800-0815, 0830-0845, 0900-0915, 0930-0945, 1000-1015, 1030-1045, 1100-1115, 1130-1145, and 1200-1215), the waters visible from land-based sites were scanned for the presence of humpback whales. When a whale was sighted, it was tallied on the data sheet and not re-counted during the same

15-minute period. Calves and adult whales were tallied in separate columns, if a distinction could be made. Only whales seen at the surface during the 15-minute period were counted. Site Leaders were asked not to record whales that surfaced before the start of the count or immediately after the 15-minute period even if they were aware of the whale's presence.

If other species of marine mammals were sighted during this 15-minute period their estimated number was also tallied, in this case without making a distinction between adults and calves, given the difficulty of this task at a distance and with untrained observers. Species likely to be sighted from land were spinner, spotted and bottlenose dolphins.

SITE MAP

This data collection procedure was designed to record the exact position of all whales observed between 1030-1100 (Figure 5), with each position, represented by a circle, containing information about the number of whales observed at that location and about pod composition (i.e., M/C for mother calf or M/C/E for mother calf escort).

BEHAVIORAL OBSERVATION PROCEDURES

The general trends in whale behavior at each site may provide an insight on the use patterns of a particular area, when looked at over a period of several years. For example, a site where mothers spend a lot of time socializing or interacting with their calf will have a higher frequency of aerial and social behaviors than an area where whales just pass through. Trends over years of observation using a consistent methodology may provide a gauge of the importance of a particular site to humpback whales.

To achieve this goal, behavioral information was collected in a simplified manner to improve consistency among volunteers with different levels of experience (Figure 6). All volunteers at the site other than Site Leaders paired up to share the task of collecting behavioral observations, generating one data sheet per pair of volunteers. While one of the volunteers monitored the waters to observe whale behavior, the other filled out the sheet. Behavioral observations started at 0800 and continued uninterrupted until 1200. Volunteers monitored all whales visible from their post and tallied any occurrence of specific behaviors as follows:

BREACH – the act of jumping out of the water by the whale. A breach may show the full body of the whale or only a portion depending on the speed of exit from the water.

SLAP – the forceful beating of the water surface by the whale with any part of the body such as the flukes, the pectoral fins, or the rostrum.

BLOW – the breath of the whale characterized by the opening and closing of the blowhole at the surface. This behavior generates a plume of vapor visible at a distance.

2003 SANCTUARY OCEAN COUNT

SITE MAP

(SAMPLE)

Date: _____ Island: _____

Site # / Name / Elevation: _____ / _____ / _____

Volunteer Name(s): _____

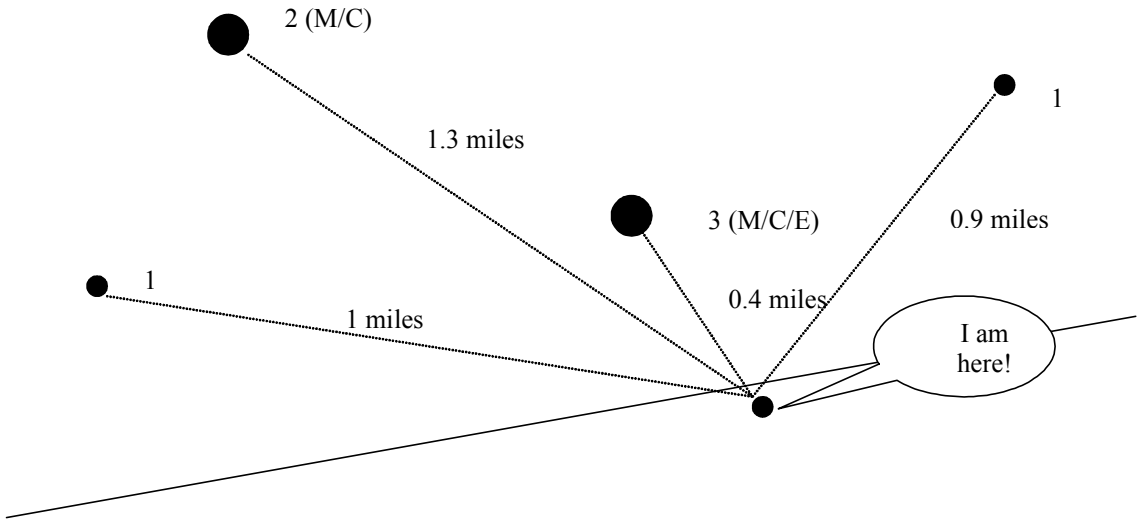
Visibility:

Fog (Y) N Heavy (Medium) Light Rain (Y) N (Heavy) Medium Light Haze Y (N) Heavy Medium Light Wind (Y) N (Strong) Medium Light

Foam (Y) N (Lots) Some None Swell (Y) N High Medium (Small/None) Visibility Code _____ (do not write in here – code will be decided by data analyst)

Observation Time: 1030 a.m. – 1100 a.m.

Draw a map of your site and specify your observation spot



Between **1030 and 1100** map all the pods present at your site using a dot. Next to the dot, write the number of whales in the pod (could be only one), and if there is a mother/calf pair write (M/C) next to the number, or for a mother/calf/escort group, write (M/C/E). Estimate their distance from you using the *distance estimation sheet* included in your package. Draw lines from you to the whale and write the distance along the line. Be sure to include the elevation of your site in the space provided above. See example provided on the back of this sheet.

Figure 5 – Site Map datasheet used during the 2003 Sanctuary Ocean Count

FLUKE UP DIVE – the arching of the tailstock until the flukes are completely out of the water during a dive.

The tally of behavioral events was broken up into half-hour time slots (0800-0830, 0831-0900, 0901-0930, 0931-1000, 1001-1030, 1031-1100, 1101-1130, 1131-1200). The number of adults and calves present was estimated for each time slot so that number of behavioral events could be standardized against number of whales present at the site to get a relative index of behavioral activity that could be compared across sites.

2003 SANCTUARY OCEAN COUNT
BEHAVIOR SHEET

Name: _____ Island: _____

Address: _____ Site # / Name: _____ / _____

_____ Date: _____

Phone: _____ Start Time: _____

E-Mail: _____ End Time: _____

Observe humpback whale activity at your site:

Time	Number of Adults	Number of Calves	Breach	Slap (Pectoral fin, Fluke, Head)	Blow	Fluke Up Dive
0800-0830	2	1	7	2	0	1
0831-0900	2	1	0	5	0	1
0901-0930	3	1	0	10	0	2
0931-1000	3	1	15	3	0	3
1001-1030	2	0	2	1	0	5
1031-1100	4	2	3	0	1	2
1101-1130	10	2	0	0	2	8
1131-1200	1	0	1	7	0	3

Describe the behavior if none of the above is occurring (Are the whales moving out of the area? Are they diving for long periods of time?):
0942 – The 3 whales are a mother/calf/escort type of pod and the calf is performing most of the breaching. Mother is recalling the calf with tail slaps.
1022 – The previous group left the area and two whales arrived in separate pods. The main activity is prolonged dives. Not much time is spent at the surface.
1048 – Mother/calf/escort pod (3) plus mother/calf pod two miles apart. All whales are moving through the area.
1115 – Lots of whale activity. Most whales appear to be moving through. Long dives.

Figure 6 – Behavior Sheet used during the 2003 Sanctuary Ocean Count

RESULTS

VOLUNTEER PARTICIPATION AND DATA REPORTING

One-thousand and ten volunteers participated to the 2003 Sanctuary Ocean Count on the Island of O′ahu, as compared to 965 in the year 2002 (Table 1). At least 421 signed up on Hawai′i as compared to 459 in 2002 (Table 2). On Kaua′i, 294 volunteers participated in 2003, a 35% increase from 2002 (Table 3). There was some disparity in attendance at different sites.

Overall, data return was good although information for a few sites was lost or not returned. This loss of information affects the data analysis, increasing error and guess work, and it should be minimized, where possible, in the future. It is especially critical to make sure that participants do not leave the site before the prescribed time (even if there are no whales present), and provide completed datasheets.

Table 1 – Comparison between the total number of participants for O′ahu's sites in January, February, and March 2002 and 2003.

Site No.	Site Name	2002	2003
1	Ewa Beach	38	24
2	Ko' Olina	38	53
3	Maili Point	39	61
4	Makua Cave	35	18
5	Ka' ena Point (West Shore)	33	33
6	Ka' ena Point (North Shore)	25	20
7	Mokuleia	55	29
8	Pua ena Point	44	31
9	Shark's Cove	34	47
10	Turtle Bay	50	55
11	Laie Pt.	25	33
12	Hau'ula	13	19
13	Kualoa	24	38
14	Pyramid Rock	33	25
15	Mokapu Point	25	24
16	Lanikai	29	25
17	Waimanalo	33	44
18	Makapu'u Point	32	30
19	Halona Blowhole	63	75
20	Lanai Lookout	62	65
21	Hanauma Bay	41	54
22	Spitting Caves	34	44
23	Diamond Head	50	47
24	Magic Island	47	42
25	Kaka'ako	55	66
26	Lahilahi Point	8	8
	Total	965	1010

Table 2 - Comparison between the total number of participants for Hawai′i's sites in January, February, and March 2002 and 2003. Sites with an asterisk (*) indicate incompleteness in the records so that a total number of volunteers could not be calculated.

Site No.	Site Name	2002	2003
1	Punalu'u Black Sand Beach Park	11	10
2	Ka Lae Park	19	25
3	Miloli'i Lookout	*	6
4	Ho'okena Beach Park	10	18
5	Honaunau Lookout	22	21
6	Keauhou	26	23
7	Keahole OTEC	37	19
8	Hualalai 4-seasons	37	32
9	Mile Marker 7	15	14
10	Pu'ukohola Heiau	20	11
11	Lapakahi State Park	22	24
12	Kapa'a Beach Park	20	19
13	Old Coast Guard Road	12	11
14	Upolu Point	13	8*
15	Waipio Valley Lookout	16	16
16	Laupahoehoe Scenic Lookout	24	23
17	Onekahakaha Beach Park	27	35
18	Kumakahi Lighthouse	30	27
19	Kehena Lookout	18	16
20	Ka'ena Point	9	16
21	Pauka'a Point	27	19
22	O'okala	24	36
23	Royal Kona	20	0
	Total	459	421

Table 3 - Comparison between the total number of participants for Kaua′i's sites in January, February, and March 2002 and 2003.

Site No.	Site Name	2002	2003
1	Lumahai Lookout	8	12
2	Princeville	21	24
3	Kilauea Lighthouse	24	28
4	Crater Hill East	16	28
5	Kapaa Lookout	14	22
6	Ahukini Landing	10	19
7	Ninini Lighthouse	27	19
8	Mahaulepu Haula	24	20
9	Mahaulepu Makawehi	13	22
10	Makahuena	15	20
11	Poipu Beach Park	17	35
12	Kaiwa Point	16	20
13	Port Allen Cemetery	0	10
14	Waimea Canyon Drive	2	6
15	St. Theresa School	9	0
16	PMRF	2	9
	Total	218	294

DEFINITIONS

For additional clarity in interpreting results found in this report the following definitions are necessary:

NUMBER OF WHALES: is used to indicate the actual number of individual whales present, each whale being recorded only once in a count cycle.

NUMBER OF SIGHTINGS: is used to indicate the number of times a body part of a whale, or the vapor generated by a whale's breath was seen and recorded by a volunteer. Number of sightings is used when individual whales may be counted more than once in a dataset.

CENSUS RESULTS (and some comparisons with 2002)

O′AHU

There was an average of two whales ($\times$=1.52; S.E.=0.35) present per site in January, February ($\times$=2.15; S.E.=0.38), and March ($\times$=2.21; S.E.=0.15) around O′ahu. Laie Point, Makapu′u Point, and Hanauma Bay had the greatest averages in January (Table 4), Laie Point, Lanai Lookout and Hanauma Bay in February (Table 5), and March (Table 6). The total number of whales counted around O′ahu between 0800 and 1215 was 26-64 in January (Table 4), 37-76 in February (Table 5), and 35-50 in March 2003 (Table 6).

A two way ANOVA coupled with a Tukey multiple comparison test was used to detect possible statistical differences in average number of whales present between 2002 and 2003 and among January, February, and March. These differences were statistically significant (ANOVA: F=16.640; P = <0.001), with February tallying a greater number of whales than January and March for both years involved (Figure 7). The only statistically significant difference between years was between March 2002 and 2003 (Tukey: q=3.434; P=0.019).

Table 4 – Summary of O′ahu's census data for January 2003. Averages reflect the average number of whales counted per site, while totals reflect the total number of whales counted around the island for each time slot.

#	Site Name	0800-0815	0830-0845	0900-0915	0930-0945	1000-1015	1030-1045	1100-1115	1130-1145	1200-1215
1	Ewa Beach	0	0	0	0	0	0	0	0	0
2	Ko' Olina	0	0	0	0	0	0	0	0	0
3	Maili Point	0	0	0	0	0	0	0	0	0
4	Makua Cave	1	2	1	2	3	3	0	0	0
5	Ka' ena Point (West Shore)	3	3	4	2	3	5	2	3	1
6	Ka' ena Point (North Shore)	3	4	2	3	1	1	2	0	2
7	Mokuleia	0	0	0	0	0	0	1	0	0
8	Pua ena Point	0	0	0	0	-	-	-	-	-
9	Shark's Cove	0	0	0	0	0	0	0	0	0
10	Turtle Bay	1	3	0	0	1	0	0	0	0
11	Laie Pt.	6	3	4	3	13	3	3	5	2
12	Hau'ula	0	2	0	0	2	0	0	2	0
13	Kualoa	0	0	0	0	0	0	0	0	0
14	Pyramid Rock	0	1	0	0	0	-	-	-	-
15	Mokapu Point	0	0	2	0	1	5	3	3	3
16	Lanikai	0	0	0	0	0	0	0	0	0
17	Waimanalo	0	2	0	1	0	0	0	0	0
18	Makapu'u Point	5	5	1	7	9	5	12	6	6
19	Halona Blowhole	7	6	8	3	1	3	3	2	1
20	Lanai Lookout	5	6	6	2	2	2	2	2	2
21	Hanauma Bay	9	9	5	0	3	3	10	3	0
22	Spitting Caves	2	5	5	1	0	0	0	1	3
23	Diamond Head	0	1	1	2	1	0	2	3	6
24	Magic Island	0	0	4	1	1	0	0	0	0
25	Kakaako	0	0	0	0	0	0	0	0	0
26	Lahilahi Point	0	12	0	0	0	0	0	0	0
	AVERAGES	1.62	2.46	1.65	1.04	1.64	1.25	1.67	1.25	1.08
	TOTALS	**42**	**64**	**43**	**27**	**41**	**30**	**40**	**30**	**26**

Table 5 – Summary of O′ahu's census data for February 2003. Averages reflect the average number of whales counted per site, while totals reflect the total number of whales counted around the island for each time slot.

#	Site Name	0800-0815	0830-0845	0900-0915	0930-0945	1000-1015	1030-1045	1100-1115	1130-1145	1200-1215
1	Ewa Beach	0	0	0	0	0	0	0	0	0
2	Ko' Olina	0	0	0	0	0	0	0	0	0
3	Maili Point	2	0	0	0	0	0	0	3	3
4	Makua Beach	5	2	3	0	5	2	0	0	-
5	Ka' ena Point West	2	2	2	3	3	3	0	0	0
6	Ka' ena Point North	0	0	5	2	1	6	1	1	0
7	Mokuleia	1	2	1	0	2	3	2	0	0
8	Pua ena Point	1	0	0	0	0	0	0	0	0
9	Shark's Cove	1	3	4	1	5	3	1	2	0
10	Turtle Bay	3	0	0	0	3	0	0	1	0
11	Laie	7	12	5	12	3	4	5	3	3
12	Hau'ula	0	0	0	0	0	0	0	0	0
13	Kualoa	3	6	2	4	1	2	0	0	0
14	Pyramid Rock	3	2	2	2	0	0	0	1	/
15	Mokapu Point	3	2	7	6	5	4	0	1	2
16	Lanikai Beach	0	5	7	4	0	0	3	1	0
17	Waimanalo	0	1	0	0	1	1	0	0	0
18	Makapu'u Point	4	3	4	1	3	6	3	1	1
19	Halona Blowhole	4	3	7	4	3	3	2	2	2
20	Lanai Lookout	6	6	4	2	4	5	7	5	7
21	Hanauma Bay	5	10	10	13	2	5	11	9	9
22	Spitting Caves	5	1	1	2	6	4	2	0	4
23	Diamond Head	4	0	4	2	1	1	3	2	0
24	Magic Island	0	2	3	0	0	0	1	3	2
25	Kakaako	2	2	2	2	2	2	2	2	4
26	Lahilahi Point	0	6	3	4	3	2	3	1	0
	AVERAGES	2.3	2.7	2.9	2.5	2.0	2.2	1.8	1.5	1.5
	TOTALS	**61**	**70**	**76**	**64**	**53**	**56**	**46**	**38**	**37**

Table 6 – Summary of O′ahu's census data for March 2003. Averages reflect the average number of whales counted per site, while totals reflect the total number of whales counted around the island for each time slot.

#	Site Name	0800-0815	0830-0845	0900-0915	0930-0945	1000-1015	1030-1045	1100-1115	1130-1145	1200-1215
1	Ewa Beach	0	0	0	0	0	0	0	0	0
2	Ko' Olina	0	0	0	0	0	3	0	0	0
3	Maili Point	0	0	0	0	0	0	0	0	2
4	Makua	0	0	0	0	0	0	-	-	-
5	Ka' ena Point (West)	0	0	0	0	0	0	0	0	0
6	Ka' ena Point (North)	-	3	5	4	4	8	6	5	3
7	Mokuleia	0	1	2	3	1	4	0	3	1
8	Pua ena Point	0	0	0	0	0	0	0	0	0
9	Shark's Cove	3	4	6	6	8	3	5	6	3
10	Turtle Bay	3	2	2	1	1	0	3	4	1
11	Laie	2	1	2	0	3	0	1	4	7
12	Hau'ula	0	0	0	0	0	0	0	-	-
13	Kualoa	-	1	2	0	0	0	0	1	0
14	Pyramid Rock	0	3	4	2	1	3	1	1	1
15	Mokapu Point	3	5	2	1	0	4	2	1	0
16	Lanikai Beach	1	0	0	0	1	3	2	0	0
17	Waimanalo	0	0	0	0	0	2	0	0	0
18	Makapu'u Point	2	2	3	5	10	5	7	11	11
19	Halona Blowhole	4	5	6	7	2	2	2	1	2
20	Lanai Lookout	5	4	1	2	0	3	3	5	0
21	Hanauma Bay	6	5	0	1	0	6	3	2	0
22	Spitting Caves	6	4	5	6	5	0	0	0	2
23	Diamond Head	0	0	1	2	0	4	5	3	3
24	Magic Island	0	0	0	0	0	0	0	0	0
25	Kakaako	0	0	0	0	0	0	0	0	0
26	Lahilahi Point	-	-	-	-	-	-	-	-	-
	AVERAGES	1.52	1.60	1.64	1.60	1.44	2.00	1.67	2.04	1.57
	TOTALS	**35**	**40**	**41**	**40**	**36**	**50**	**40**	**47**	**36**

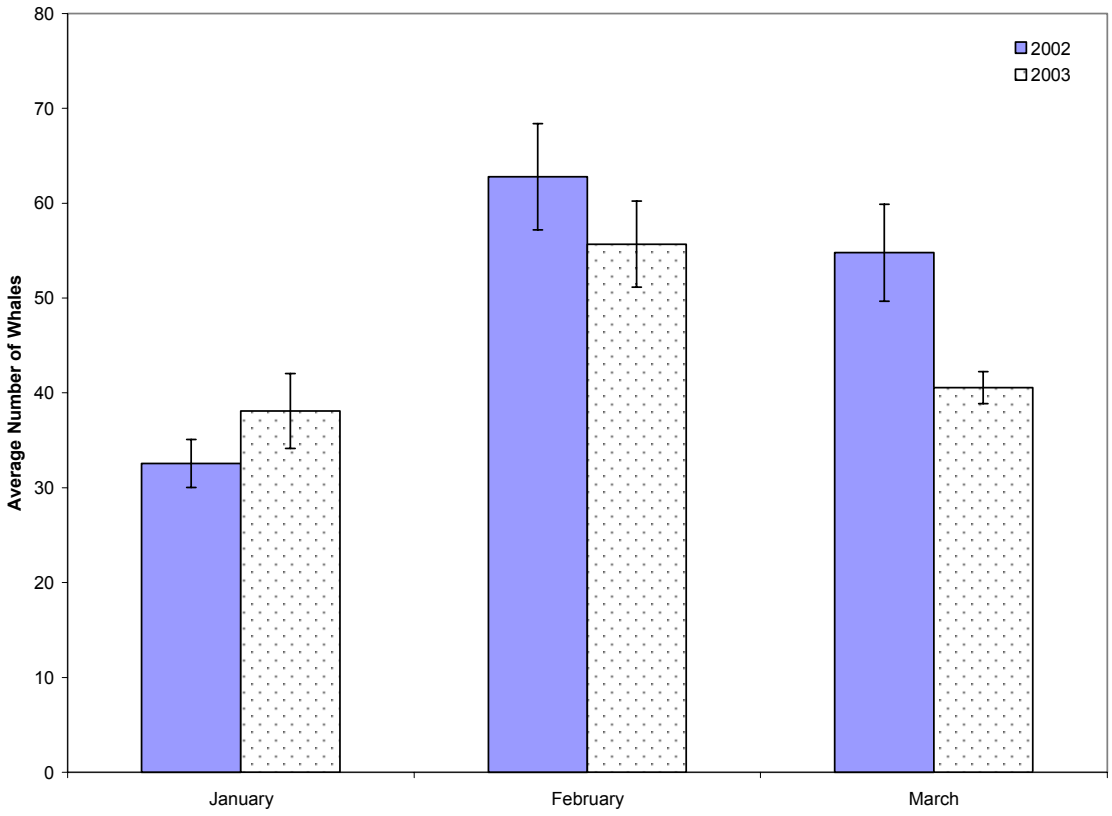


Figure 7 – Average number of whales counted around the Island of O′ahu in January, February and March 2002-2003 from 26 shore-based sites.

Number of whales counted had a tendency to decrease throughout the morning (cc=-0.273; P=0.045) for 2002 and 2003 combined (since averages were not significantly different between years data were combined). However, there was a high variability in the number of whales counted during each time slot (Figure 8).

Average number of sightings per site in January, February, and March 2003 was calculated for all sites located along the same coastline around O′ahu to compare abundance patterns. The standardization to whales per site was done to delete the effect of the different number of sites used on each coastline. Differences among coastlines (ANOVA on Ranks: $H=58.545$; $P<0.001$) and months (ANOVA on Ranks: $H=8.262$; $P<0.001$) were significant. There was also a statistically significant interaction between the two factors (ANOVA on Ranks: $F=7.763$; $P<0.001$) so that differences in number of sightings among coastlines varied in different months.

It is also important to point out that these findings do not take into account the potentially significant differences in shore-based site configuration, mainly altitude and its effects on the number of whales counted.

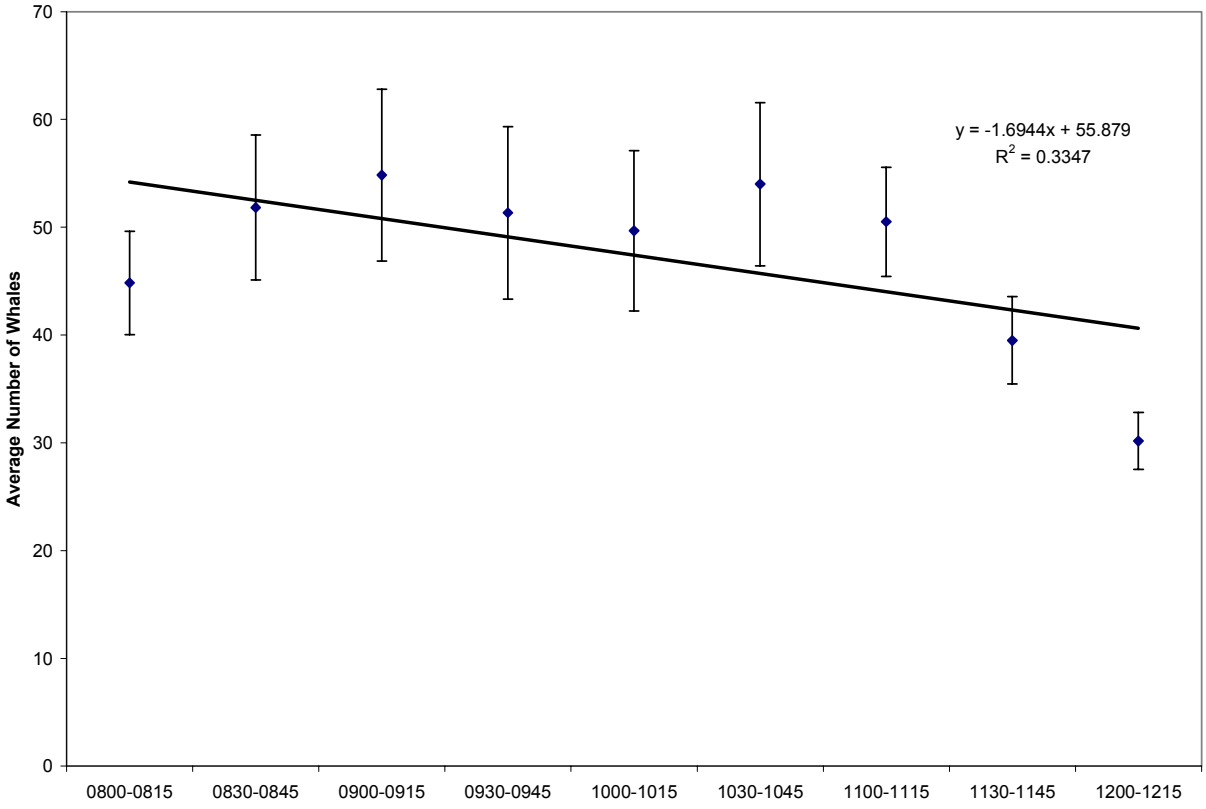


Figure 8 – Average number of whales counted during each 15-minute slot on O′ahu for January, February and March 2002 and 2003.

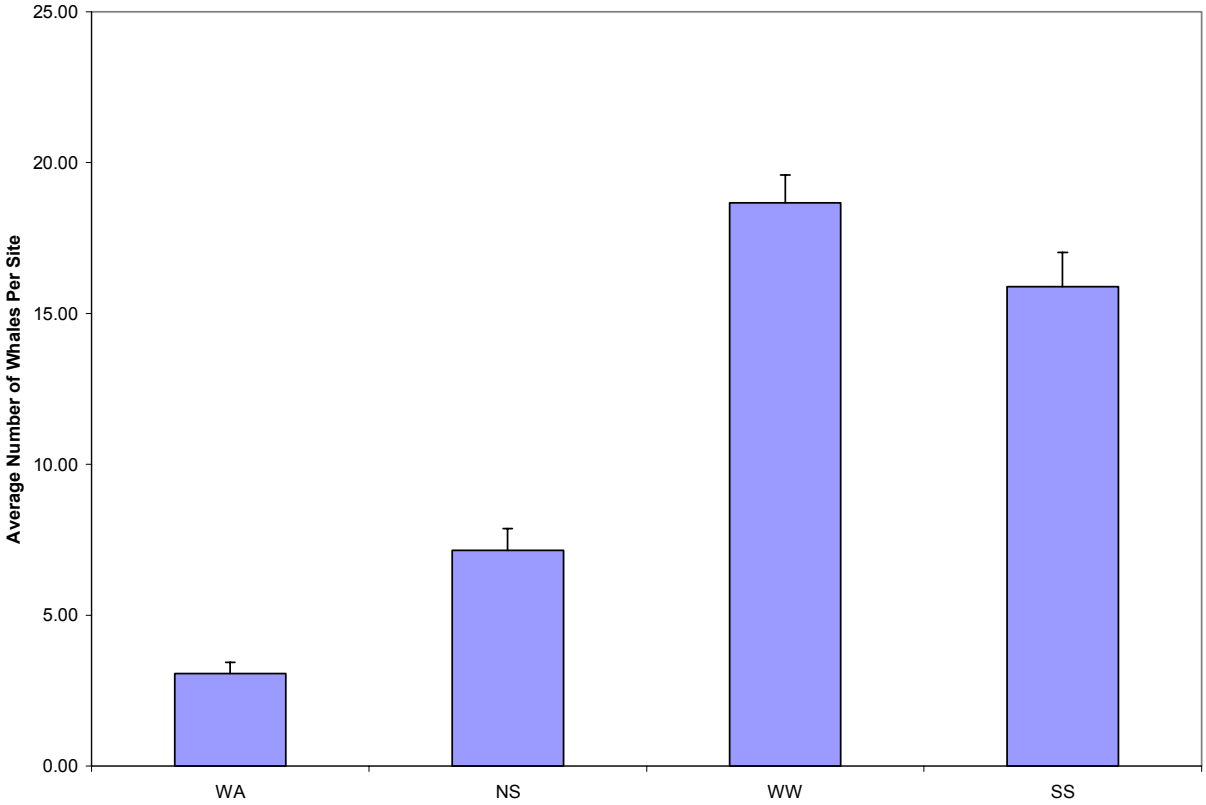


Figure 9 – Average number of whales per site counted during January, February and March 2003 along the four main coastlines of the Island of O′ahu. WA=Waianae, NS=North Shore, WW=Windward, SS=South Shore.

HAWAI'I

Three main coastlines, enjoying different exposure to the trades were identified: South Coast between Kumakahi and South Point, the Kona/Kohala Coast between South Point and Upolu Point, and the Hilo Coast between Upolu Point and Kumakahi Point. Coverage along these coastlines was not uniform and long stretches where no effort occurred were located along all coastlines. Adequate comparisons are therefore harder to make than for O′ahu. Similarly to O′ahu, sites on Hawai′i were located at different altitudes and therefore covered varying areas of water.

Number of whales counted was between 66-142 in January with one site not sampled and results for one site missing (Table 7), 80-170 in February (Table 8) and 31-59 in March, with several time slots and/or sites missing (Table 9). Number of whales sighted was, generally, greater than for O′ahu, with an average of six whales per site in January (x=5.95; S.E.=0.67), six whales per site in February (x=5.95;S.E.=0.48), and two whales per site in March (x=2.35; S.E.=0.24). The largest concentrations of whales were at Onekahakaha Beach Park, Punalu′u Beach and Ka Lae Park in January; Onekahakaha Beach Park, Mile Marker 7 and Old Coast Guard Road in February, and Onekahakaha Beach Park, Mile Marker 7 and Kapa′a in March.

Table 7 – Summary of Hawai′i's census results for January 2003. Averages reflect the average number of whales counted per site, while totals reflect the total number of whales counted around the island for each time slot.

#	Site Name	0800-0815	0830-0845	0900-0915	0930-0945	1000-1015	1030-1045	1100-1115	1130-1145	1200-1215
1	Punalu'u Black Sand Beach Park	0	13	24	30	18	27	6	11	18
2	Ka Lae Park	12	22	11	22	22	13	6	29	13
3	Mibli'i Lookout	0	0	0	0	0	0	0	0	0
4	Hookena Beach Park	2	2	0	0	0	0	0	0	0
5	Honaunau Lookout	0	0	0	0	0	0	0	-	-
6	Keauhou	0	0	0	2	5	0	1	4	4
7	Keahole OTEC	5	8	7	6	9	8	4	1	6
8	Hualalai 4-seasons	-	1	4	0	4	2	3	-	-
9	Mile Marker 7	7	9	6	16	14	13	7	14	10
10	Pu'ukohola Heiau	4	4	5	3	3	4	10	4	2
11	Lapakahi State Park	5	7	4	6	4	6	4	9	0
12	Kapa'a Beach Park	5	4	11	10	5	5	3	5	4
13	Old Coast Guard Road	5	6	5	3	7	10	5	6	10
14	Upolu Point					missing data				
15	Waipio Valley Lookout	2	5	2	4	2	0	0	-	-
16	Laupahoehoe Scenic Lookout	1	0	1	0	0	2	0	0	4
17	Onekahakaha Beach Park	17	57	31	21	35	38	28	20	35
18	Kumakahi Lighthouse	1	3	4	4	2	2	2	3	/
19	Kehena Lookout	0	0	0	0	0	0	1	1	0
20	Ka'ena Point	0	0	0	0	0	0	0	0	0
21	Pauka'a Point	-	-	-	-	-	-	-	-	-
22	O'okala	-	1	0	3	0	0	-	3	4
	AVERAGES	3.67	7.10	5.75	6.50	6.50	6.50	4.21	6.47	6.88
	TOTALS	**66**	**142**	**115**	**130**	**130**	**130**	**80**	**110**	**110**

Table 8 - Summary of Hawai'i's census results for February 2003. Averages reflect the average number of whales counted per site, while totals reflect the total number of whales counted around the island for each time slot.

#	Site Name	0800-0815	0830-0845	0900-0915	0930-0945	1000-1015	1030-1045	1100-1115	1130-1145	1200-1215
1	Punalu'u Black Sand Beach Park	0	0	0	0	0	0	0	0	0
2	Ka Lae Park	20	21	3	2	4	0	3	1	4
3	Mibli'I Lookout	0	0	0	0	1	1	2	2	2
4	Hookena Beach Park	7	4	5	6	3	0	6	0	0
5	Honaunau Lookout	2	3	6	0	0	0	0	0	0
6	Keauhou	4	6	5	6	5	5	3	5	0
7	Keahole OTEC	3	4	4	3	3	3	5	4	2
8	Hualalai 4-seasons	3	11	4	2	9	3	5	6	13
9	Mile Marker 7	24	17	18	18	23	20	11	10	9
10	Pu'ukohola Heiau	8	9	8	8	2	8	9	6	5
11	Lapakahi State Park	8	8	14	11	12	12	9	8	10
12	Kapa'a Beach Park	11	12	16	16	9	7	5	4	3
13	Old Coast Guard Road	12	17	16	23	10	8	7	12	12
14	Upolu Point	8	12	6	9	7	7	3	6	-
15	Waipo Valley Lookout	0	0	1	1	0	0	0	0	0
16	Laupahoehoe Scenic Lookout	2	3	5	8	8	7	10	5	3
17	Onekahakaha Beach Park	13	29	28	31	20	12	25	20	17
18	Kumakahi Lighthouse	0	0	0	0	0	0	0	0	0
19	Kehena Lookout	0	0	0	0	0	0	1	1	0
20	Ka'ena Point	0	0	0	0	3	2	1	0	0
21	Pauka'a Point	8	12	13	12	3	16	12	6	-
22	O'okala	4	2	4	5	8	6	5	2	0
	AVERAGES	6.23	7.73	7.09	7.32	5.91	5.32	5.55	4.45	4.00
	TOTALS	**137**	**170**	**156**	**161**	**130**	**117**	**122**	**98**	**80**

Table 9 - Summary of Hawai′i's census results for March 2003. Averages reflect the average number of whales counted per site, while totals reflect the total number of whales counted around the island for each time slot.

#	Site Name	0800-0815	0830-0845	0900-0915	0930-0945	1000-1015	1030-1045	1100-1115	1130-1145	1200-1215
1	Punalu'u Black Sand Beach Park	6	0	-	-	-	-	-	-	-
2	Ka Lae Park	5	5	0	1	0	-	-	-	-
3	Mibli'I Lookout	0	0	0	0	0	0	0	0	0
4	Hookena Beach Park	0	0	0	2	0	0	0	0	0
5	Honaunau Lookout	-	-	-	-	-	-	-	-	-
6	Keauhou	0	0	0	0	0	1	0	3	2
7	Keahole OTEC	0	0	0	2	2	5	3	0	0
8	Hualalai 4-seasons	6	0	0	0	0	0	2	0	2
9	Mile Marker 7	9	7	10	12	8	7	5	5	5
10	Pu'ukohola Heiau	0	0	0	0	2	0	0	0	0
11	Lapakahi State Park	0	1	3	4	3	5	7	10	0
12	Kapa'a Beach Park	2	3	2	5	4	6	7	6	6
13	Old Coast Guard Road	3	2	5	4	5	8	0	0	0
14	Upolu Point	-	-	-	-	-	-	-	-	-
15	Waipo Valley Lookout	0	0	2	1	0	0	0	3	0
16	Laupahoehoe Scenic Lookout	3	5	0	0	0	2	0	0	0
17	Onekahakaha Beach Park	6	16	8	9	4	12	12	9	6
18	Kumakahi Lighthouse	1	0	1	0	0	0	0	0	0
19	Kehena Lookout	0	0	0	2	0	1	0	1	3
20	Ka'ena Point	0	0	2	0	0	0	0	0	0
21	Pauka'a Point	5	2	7	0	0	7	9	5	5
22	O'okala	3	4	3	5	4	5	1	2	2
	AVERAGES	2.45	2.25	2.26	2.47	1.68	3.28	2.56	2.44	1.72
	TOTALS	**49**	**45**	**43**	**47**	**32**	**59**	**46**	**44**	**31**

The difference in the average number of whales among the different months was statistically significant (ANOVA: F=67.550; P = <0.001), while differences between years were not. In general, a greater number of whales was present in February than in January and March for both years involved (Figure 10). March counts dropped considerably in both years (Figure 10).

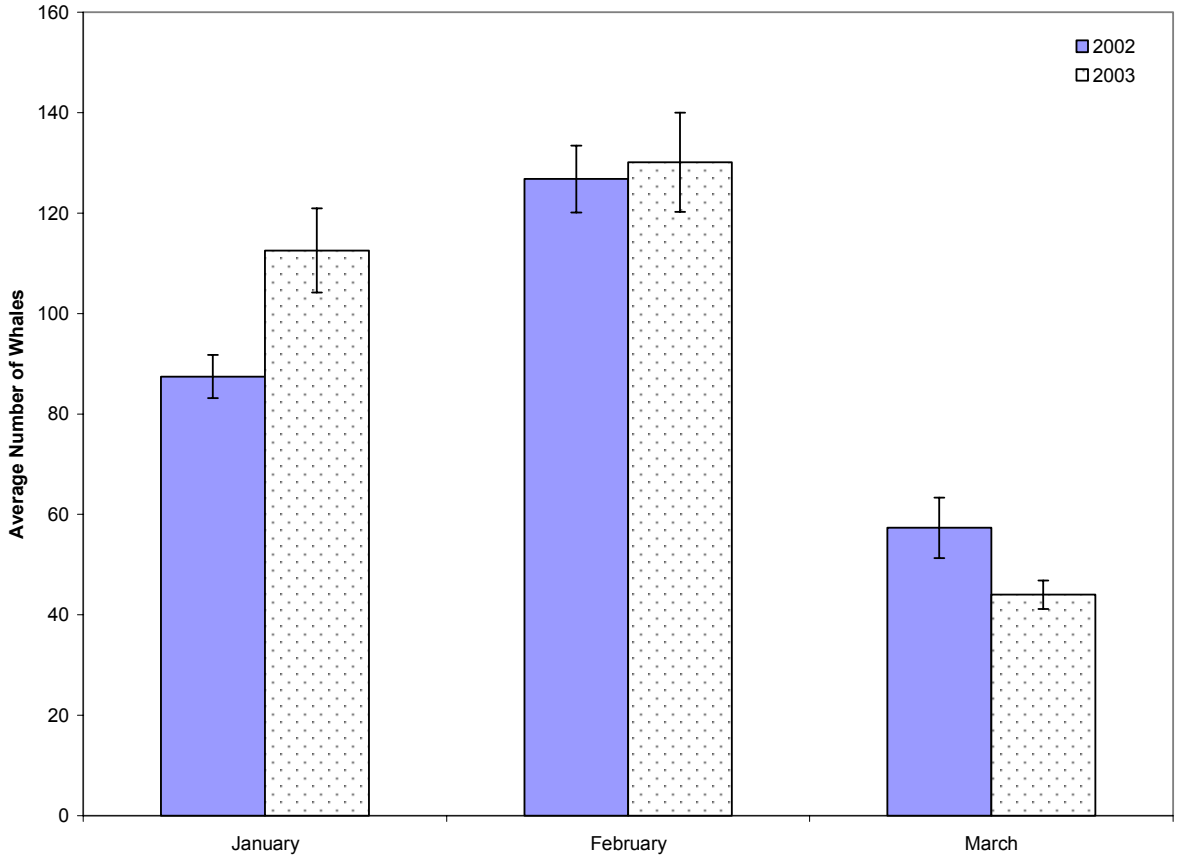


Figure 10 - Average number of whales counted around the Island of Hawai′i in January, February and March 2002-2003 from 26 shore-based sites.

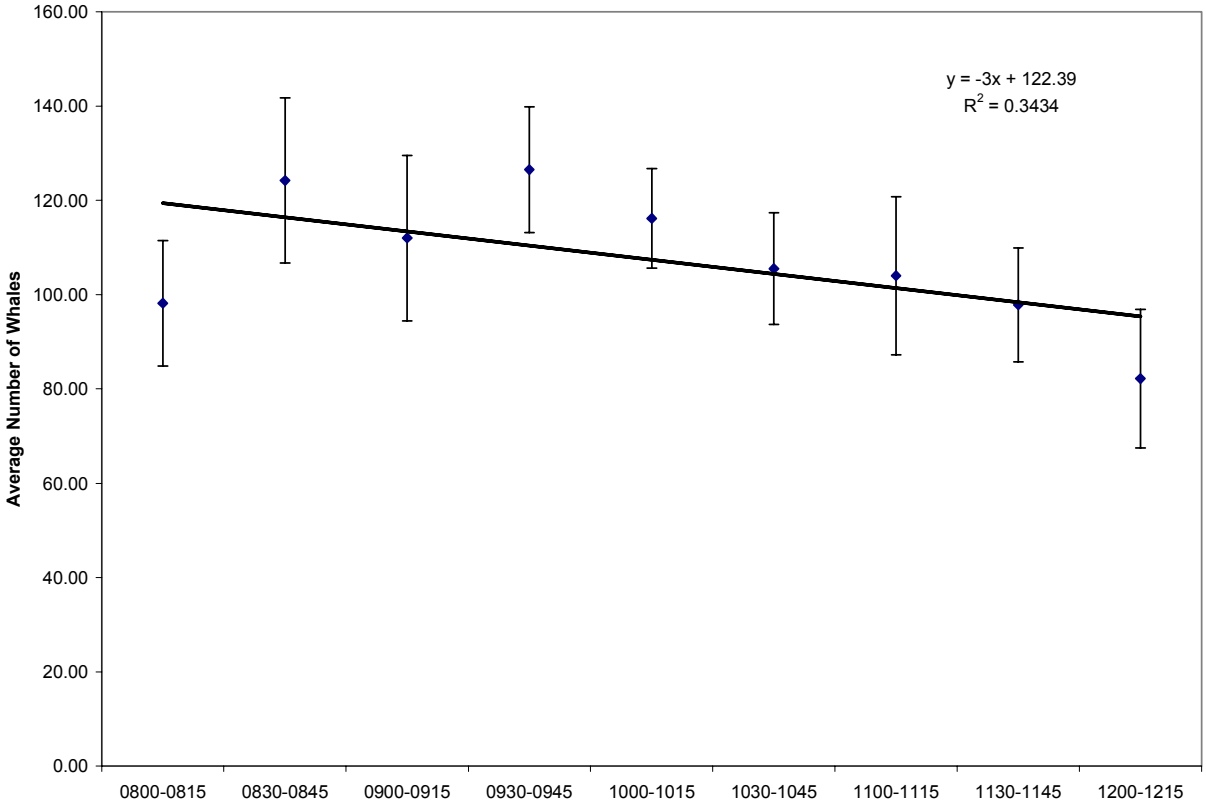


Figure 11 - Average number of whales counted during each 15-minute slot on Hawai′i for January, February and March 2002 and 2003.

The average number of whales was not significantly different among time slots (ANOVA: F=0.384; P=0.924) for 2002 and 2003 combined (since averages were not significantly different between years data were combined). However, there was a high variability in the number of whales counted during each time slot (Figure 11). Counts tended to decrease throughout the morning but the correlation was not significant.

Average number of sightings per site in January, February, and March 2003 was calculated for all sites located along the same coastline around Hawai′i to compare abundance patterns. The standardization to whales per site was done to delete the effect of the different number of sites used on each coastline. Differences among coastlines (ANOVA on Ranks: H=43.313; P<0.001) and months (ANOVA on Ranks: H=59.663; P<0.001) were significant. There was also a statistically significant interaction between the two factors (ANOVA on Ranks: F=16.757; P<0.001) so that differences in number of sightings among coastlines varied in different months. Differences among coastlines were significant in February and March.

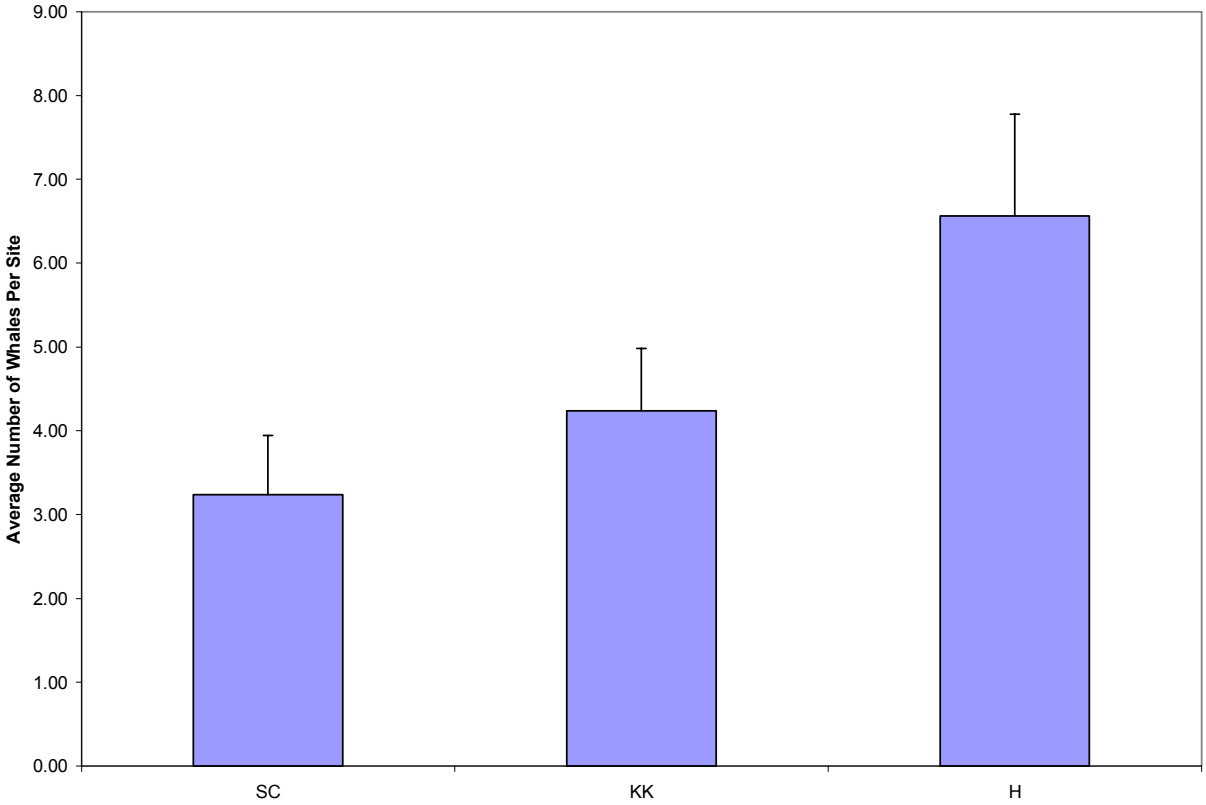


Figure 12 – Average number of whales counted per site during January, February and March 2002-2003 along the three main coastlines of the Island of Hawai′i. SC=South Coast, KK=Kona/Kohala Coast, H=Hilo Coast.

KAUAI'I: CENSUS RESULTS

On Kaua′i, number of sightings varied from 38-93 in January, 44-81 in February, and 25-40 in March. Average number of whales sighted was higher than O′ahu's and lower than Hawai′i's, with five whales per site in January (x=5.05; S.E.=1.09), four whales per site in February (x=4.42; S.E.=0.68) and two whales per site in March (x=2.15; S.E.=0.12). As for O′ahu and Hawai′i, sites were located at different altitudes and therefore cover different areas of water.

Coverage on Kaua′i excluded a large portion of the north-western shoreline, which is not easily accessible and steep. This increases underestimation of whale activity around the island to a higher degree than around O′ahu and Hawai′i. For this reason, whale abundance by coastline was calculated only for the Eastern Shore, Kapa′a Lookout to Maha′ulepu and the South-Western Shore, Maha′ulepu to Port Allen.

Table 10 - Summary of Kaua′i's census results for January 2003. Averages reflect the average number of whales counted per site, while totals reflect the total number of whales counted around the island for each time slot.

#	Site Name	0800-0815	0830-0845	0900-0915	0930-0945	1000-1015	1030-1045	1100-1115	1130-1145	1200-1215
1	Lumahai Lookout	3	1	1	0	2	4	5	9	3
2	Princeville	0	0	0	0	1	0	2	2	2
3	Kilauea Lighthouse	1	0	0	2	1	0	1	1	1
4	Crater Hill East	0	3	0	2	0	1	2	1	3
5	Kapaa Lookout	3	5	6	5	7	6	5	4	4
6	Ahukini Landing	2	3	7	5	2	3	4	6	9
7	Ninini Lighthouse	6	10	5	10	13	9	7	10	4
8	Mahaulepu Haula	5	10	9	8	6	6	7	8	6
9	Mahaulepu Makawehi	3	10	14	13	8	13	7	15	12
10	Makahuena	3	7	10	7	13	15	16	10	12
11	Poipu Beach Park	2	4	0	2	3	9	4	5	1
12	Kaiwa Point	8	22	28	9	1	5	9	21	20
13	Port Allen Cemetery	2	7	10	12	8	2	2	0	0
14	Waimea Canyon Drive	0	0	0	0	1	0	2	1	3
15	St. Theresa School	-	-	-	-	-	-	-	-	-
16	PMRF	0	0	0	0	0	0	0	-	-
	AVERAGES	2.53	5.47	6.00	5.00	4.40	4.87	4.87	6.64	5.71
	TOTALS	**38**	**82**	**90**	**75**	**66**	**73**	**73**	**93**	**80**

Table 11 - Summary of Kaua′i's census results for February 2003. Averages reflect the average number of whales counted per site, while totals reflect the total number of whales counted around the island for each time slot.

#	Site Name	0800-0815	0830-0845	0900-0915	0930-0945	1000-1015	1030-1045	1100-1115	1130-1145	1200-1215
1	Lumahai Lookout	1	2	3	1	3	0	5	2	1
2	Princeville	8	5	8	4	6	7	2	4	5
3	Kilauea Lighthouse	3	2	4	10	6	11	10	6	2
4	Crater Hill East	2	2	4	3	5	10	4	5	4
5	Kapaa Lookout	9	9	6	7	6	4	4	5	2
6	Ahukini Landing	9	6	8	2	5	6	5	10	9
7	Ninini Lighthouse	1	2	4	7	10	5	3	4	7
8	Mahaulepu Haula	9	11	14	4	3	4	6	2	3
9	Mahaulepu Makawehi	19	27	14	8	1	4	6	4	1
10	Makahuena	7	6	7	5	7	6	4	4	4
11	Poipu Beach Park	2	0	2	1	0	2	4	5	0
12	Kaiwa Point	0	0	2	0	1	2	1	1	1
13	Port Allen Cemetery	1	3	0	0	0	0	0	0	0
14	Waimea Canyon Drive	-	-	-	-	-	-	-	-	-
15	St. Theresa School	-	-	-	-	-	-	-	-	-
16	PMRF	1	1	5	6	2	1	2	1	5
	AVERAGES	5.14	5.43	5.79	4.14	3.93	4.43	4.00	3.79	3.14
	TOTALS	**72**	**76**	**81**	**58**	**55**	**62**	**56**	**53**	**44**

Table 12 - Summary of Kaua′i's census results for March 2003. Averages reflect the average number of whales counted per site, while totals reflect the total number of whales counted around the island for each time slot.

#	Site Name	0800-0815	0830-0845	0900-0915	0930-0945	1000-1015	1030-1045	1100-1115	1130-1145	1200-1215
1	Lumahai Lookout	0	0	0	0	0	3	0	0	1
2	Princeville	0	0	0	0	0	0	1	0	0
3	Kilauea Lighthouse	3	0	1	0	0	4	1	1	3
4	Crater Hill East	2	0	0	1	2	6	6	0	5
5	Kapaa Lookout	2	1	0	0	1	1	0	1	5
6	Ahukini Landing	3	5	1	1	2	7	6	4	3
7	Ninini Lighthouse	2	6	11	11	6	4	2	4	3
8	Mahaulepu Haula	3	5	2	2	2	2	2	1	1
9	Mahaulepu Makawehi	0	0	0	0	0	1	3	3	1
10	Makahuena	1	0	0	0	0	0	2	3	3
11	Poipu Beach Park	0	0	0	0	0	0	4	2	0
12	Kaiwa Point	7	11	8	9	10	10	6	3	5
13	Port Allen Cemetery	2	2	4	2	2	2	2	4	2
14	Waimea Canyon Drive	-	-	-	-	-	-	-	-	-
15	St. Theresa School	-	-	-	-	-	-	-	-	-
16	PMRF	3	0	0	0	0	0	0	0	2
	AVERAGES	2.00	2.14	1.93	1.86	1.79	2.86	2.50	1.86	2.43
	TOTALS	**28**	**30**	**27**	**26**	**25**	**40**	**35**	**26**	**34**

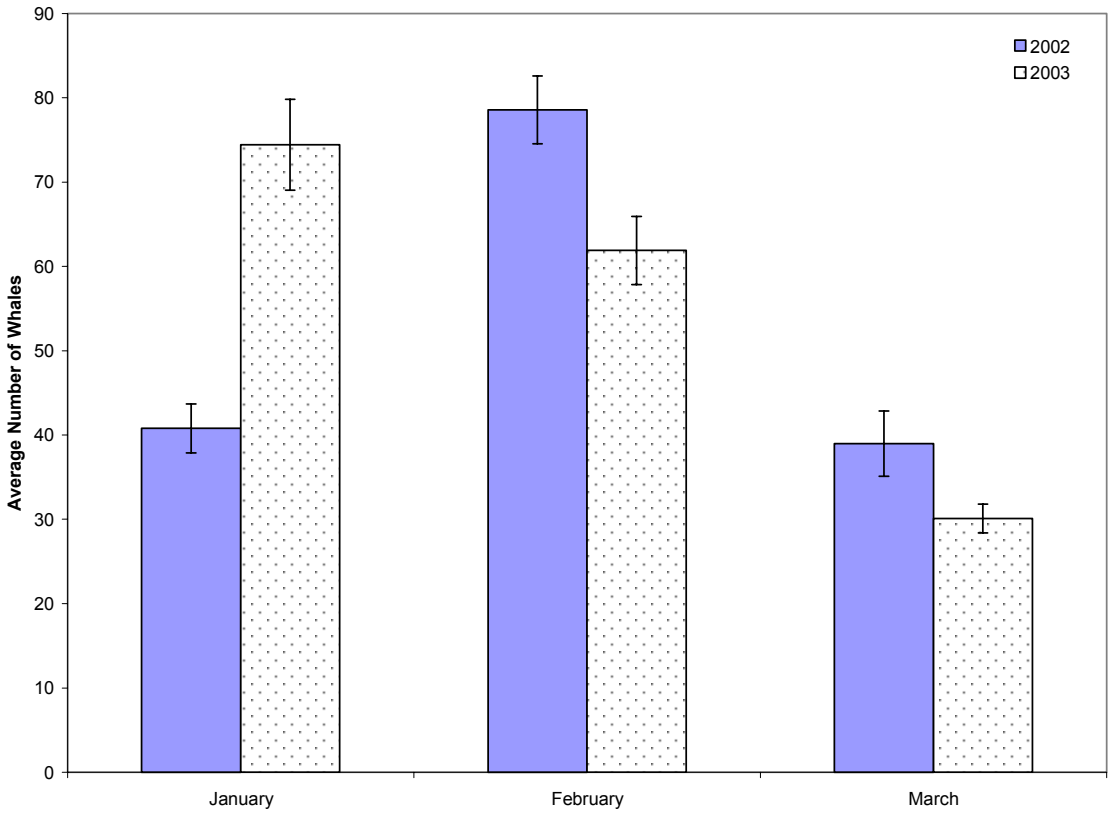


Figure 13 - Average number of sightings recorded around the Island of Kaua′i in January, February and March 2002-2003.

There was a significant difference in average number of whales per month (ANOVA: F=44.878; P = <0.001), while the difference between years was not (Figure 13). There was a statistically significant interaction between month and year (ANOVA: F=25.180; P = <0.001). There was a statistically significant difference between 2002 and 2003 in both January (q=8.818; P<0.001) and February (q= 4.365; P=0.004). In 2002 February was significantly higher than January and March (P<0.001), while in 2003 March was significantly lower than both January and February (P<0.001).

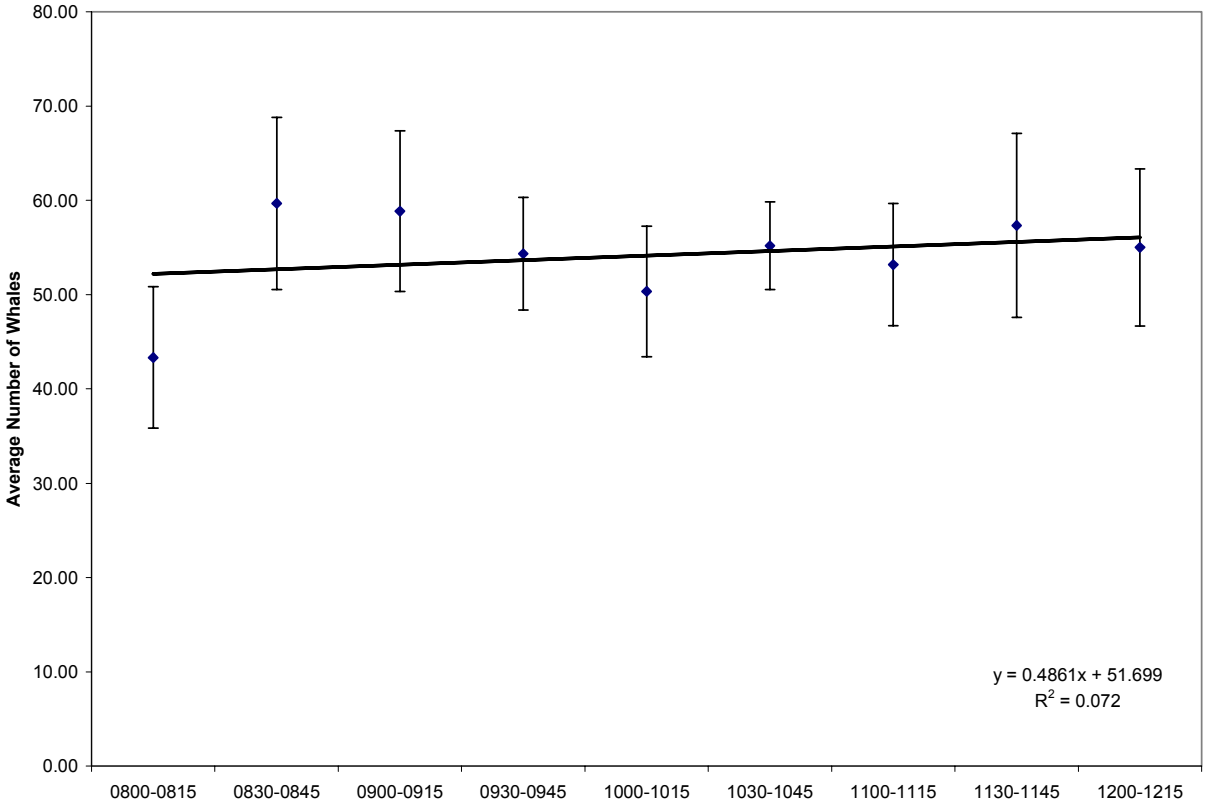


Figure 14 - Average number of whales counted during each 15-minute slot on Kauai′i for January, February and March 2002 and 2003.

The average number of whales was not significantly different among time slots (ANOVA: F=0.281; P=0.969) for 2002 and 2003 combined (since averages were not significantly different between years data were combined). However, there was a high variability in the number of whales counted during each time slot (Figure 14).

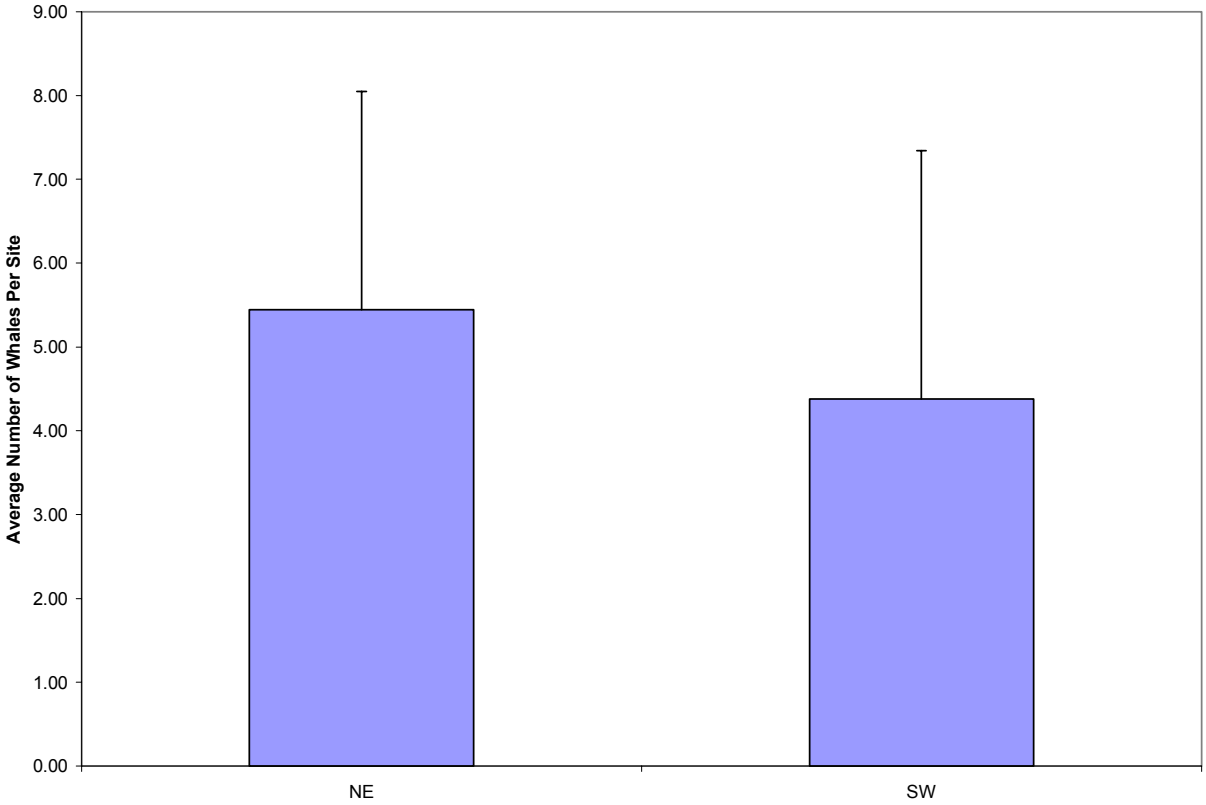


Figure 15 – Average number of whales counted per site during January, February and March 2002-2003 along two coastlines of the Island of Kaua′i. NE=North-East Coast, SW=South-West Coast.

Average number of sightings per site in January, February, and March 2003 was calculated for all sites located along the same coastline around Kaua′i to compare abundance patterns (Figure 15). The standardization to whales per site was done to delete the effect of the different number of sites used on each coastline. Differences among coastlines (ANOVA: $F=24.483$; $P<0.001$) and months (ANOVA: $F=39.945$; $P<0.001$) were significant. There was also a statistically significant interaction between the two factors (ANOVA: $F=13.570$; $P<0.001$) so that differences in number of sightings among coastlines varied in different months. Differences among coastlines were significant in February.

KAHO'OLAWE: CENSUS RESULTS

Kaho'olawe counted whales at a single site located at Kui Kui. Volunteers from the Kaho'olawe Island Reserve Commission (KIRC), the Island Marine Institute, and the Maui Sanctuary Office participated at this site. Because only marine biologist or trained professionals participated at this site, additional information was provided such as theodolite mapped positions of all whales seen at the site, and tracking of individual pods. These data were collected for the internal planning and management at the KIRC, but such information will be useful for long-term interpretation of the patterns occurring at this site.

Table 13 - Summary of Kaho'olawe census results for January, February, and March 2003. Data reflect the total number of whales counted at the Kui Kui site for each time slot. The March count on Kaho'olawe was completed on 5 April instead of 29 March 2003.

Month	0800-0815	0830-0845	0900-0915	0930-0945	1000-1015	1030-1045	1100-1115	1130-1145	1200-1215
Jan	4	3	3	2	6	6	0	0	7
Feb	7	17	18	13	13	10	13	10	9
Mar	4	4	0	3	5	8	8	4	2

SITE MAP DATA

Site map data will be used in the future to plot whale distribution using Geographic Information Systems. The database for this information is currently being developed.

Counts obtained between 1030 and 1100 (reported in the Site Map sheet) were compared to census counts (reported in the Census Sheet) for the timeslot 1030-1045 (Tables 14-16). This provided a gage for consistency between volunteer teams.

In general, number of whales counted while compiling the Site Map sheet was higher than whales counted during the regular census (Tables 14-16). This may be due to the fact that whales were counted for a half-hour period during the compilation of the Site Map sheet and only for fifteen minutes during the actual census. Another possible explanation is that the same whale was plotted more than once during mapping.

The comparative data emphasize the variability between observers and the uncertainties related to the fact that data are being collected by untrained individuals, with little to no possibility to evaluate the reliability of the information collected. Once again, results should be interpreted with extreme caution.

Table 14 – Comparison between site map data and census data for the Island of O′ahu. Site elevation was measured in feet. Bold print indicates an unreliable site.

		January		February		March	
Elevation	**Site Name**	**Map Data**	**Census**	**Map Data**	**Census**	**Map Data**	**Census**
10	Ewa Beach	0	0	0	0	0	0
20	Ko' Olina	0	0	0	0	5	3
100	Maili Point	0	0	0	0	0	0
20	Makua Cave	3	3	2	2	0	0
20	Ka' ena Point (West Shore)	6	5	3	3	0	0
20	Ka' ena Point (North Shore)	4	1	4	6	9	8
20	Mokuleia	0	0	3	3	2	4
20	Pua ena Point	-	-	1	0	0	0
30	Shark's Cove	0	0	3	3	6	3
20	Turtle Bay	0	0	0	0	-	-
40	Laie Pt.	5	3	6	4	2	0
4	Hau'ula	0	0	0	0	-	-
150	Kualoa	0	0	8	2	0	0
60	Pyramid Rock	0	-	3	0	5	3
120	Mokapu Point	4	5	7	4	5	4
30	Lanikai	0	0	5	0	6	3
0	Waimanalo	0	0	1	1	7	2
400	Makapu'u Point	8	5	3	6	3	5
70	**Halona Blowhole**	**12**	**3**	1	3	**19**	**2**
80	**Lanai Lookout**	**10**	**2**	6	5	9	3
40	**Hanauma Bay**	**10**	**3**	8	5	0	6
80	Spitting Caves	0	0	8	4	0	0
100	Diamond Head	0	0	3	1	-	4
10	Magic Island	0	0	2	0	0	0
10	Kaka'ako	0	0	0	2	0	0
100	Lahilahi Point	-	0	2	2	-	-
	Total	62	30	79	56	78	50

Table 15 – Comparison between site map data and census data for the Island of Hawai′i. Site elevation was measured in feet. Bold print indicates an unreliable site.

		January		February		March	
Elevation	**Site Name**	**Map Data**	**Census**	**Map Data**	**Census**	**Map Data**	**Census**
20	**Punalu'u Black Sand Beach Park**	**6**	**27**	0	0	-	-
20	Ka Lae Park	-	-	3	0	-	-
800	Miloli'i Lookout	0	0	2	1	0	0
20	Ho'okena Beach Park	0	0	2	0	0	0
200	Honaunau Lookout	0	0	20	0	-	-
450	Keauhou	2	0	5	5	1	1
20	**Keahole OTEC**	**14**	**8**	8	3	0	5
20	**Hualalai 4-seasons**	**17**	**2**	8	3	5	0
180	Mile Marker 7	19	13	20	20	5	7
124	Pu'ukohola Heiau	9	4	9	8	0	0
40	**Lapakahi State Park**	**14**	**6**	15	12	11	5
20	**Kapa'a Beach Park**	**11**	**5**	**15**	**7**	8	6
20	Old Coast Guard Road	8	10	9	8	8	8
40	Upolu Point	-	-	13	7	-	-
880	Waipio Valley Lookout	0	0	0	0	0	0
400	Laupahoehoe Scenic Lookout	2	2	8	7	2	2
0	**Onekahakaha Beach Park**	**14**	**38**	**0**	**12**	13	12
30	Kumakahi Lighthouse	2	2	1	0	0	0
60	Kehena Lookout	0	0	2	0	2	1
35	**Ka'ena Point**	0	0	**14**	**2**	0	0
-	Pauka'a Point	-	-	9	16	7	7
265	**O'okala**	0	0	**30**	**6**	9	5
	Total	118	117	193	117	71	59

Table 16 – Comparison between site map data and census data for the Island of Kauai′i. Site elevation was measured in feet. Bold print indicates an unreliable site.

		January		February		March	
Elevation	**Site Name**	**Map Data**	**Census**	**Map Data**	**Census**	**Map Data**	**Census**
10	**Lumahai Lookout**	**15**	**4**	5	0	0	3
20	Princeville	0	0	6	7	3	0
100	Kilauea Lighthouse	2	0	12	11	4	4
20	Crater Hill East	3	1	9	10	6	6
20	**Kapaa Lookout**	**25**	**6**	5	4	0	1
20	Ahukini Landing	3	3	7	6	7	7
20	Ninini Lighthouse	9	9	9	5	4	4
25	Mahaulepu Haula	6	6	0	4	2	2
30	**Mahaulepu Makawehi**	14	13	**15**	**4**	2	1
20	Makahuena	14	15	9	6	-	-
40	Poipu Beach Park	11	9	4	2	0	0
4	Kaiwa Point	4	5	2	2	11	10
150	Port Allen Cemetery	2	2	-	0	3	2
60	Waimea Canyon Drive	3	0	-	-	-	-
120	St. Theresa School	-	-	-	-	-	-
30	PMRF	0	0	2	1	0	0
	Total	111	73	111	62	42	40

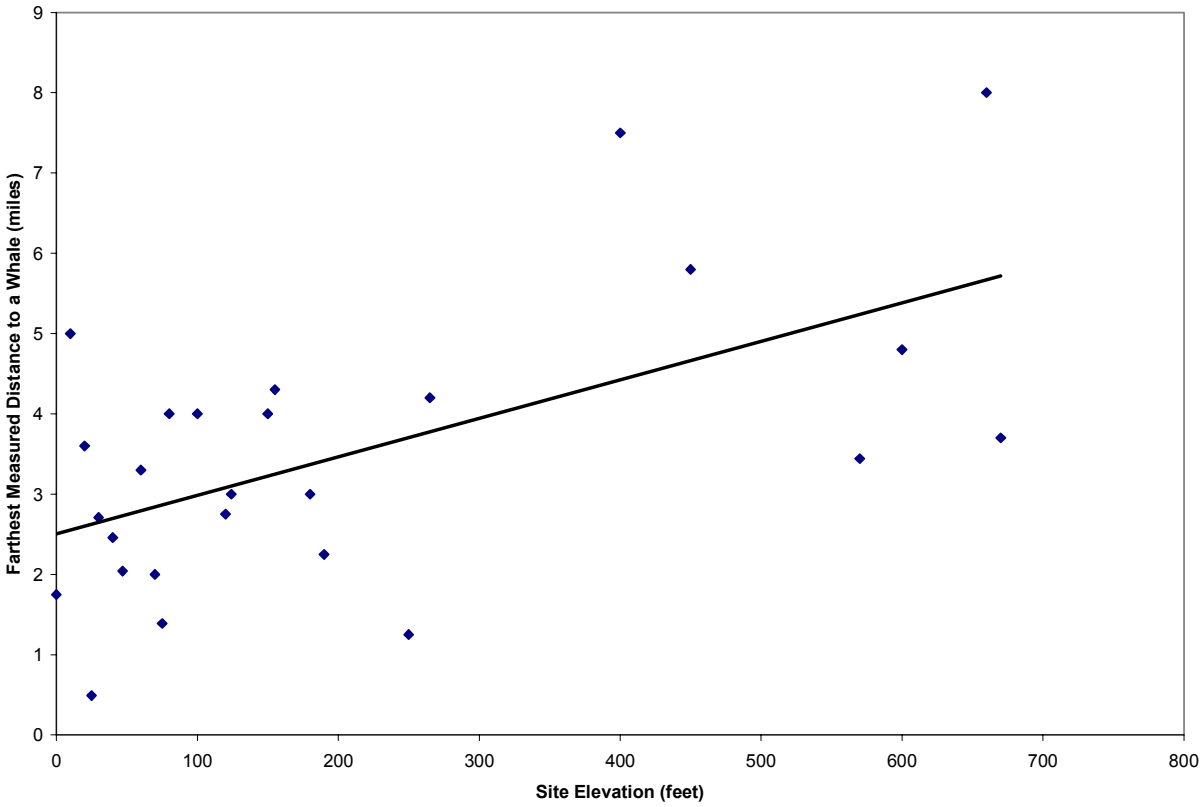


Figure 16 – Relationship between site elevation and farthest distance to a whale recorded at that elevation.

There was a positive correlation between site elevation and farthest distance to a whale recorded at that elevation (Figure 16). This relationship is intuitive and confirms the bias incurred when comparing number of whales seen at sites with different elevation.

However, the majority of the calculated shore-to-whale distances were less than 4.0 miles, a distance which can be easily sampled from an elevation of approximately 10 feet (Figure 17). This suggests that the bias incurred at sites higher in elevation may not be large since most whales are located close to shore. Alternatively, whales located farther from shore are not easy to sample despite site elevation because of limitations due to weather, cryptic behavior and lack of binoculars. Herman and Antinoja (1977) and Mobley *et al.* (1999) reported that humpback whales are mostly found in waters less than 182 m deep, but these depths could be located well beyond the 4.0 mile distance from shore. Opportunistic aerial surveys by Maldini (2003) showed that humpback whales around O′ahu can be abundant beyond four miles from the shoreline (Figure 18). This was also the case for whales seen from the Kaho′olawe site, where distances were calculated precisely with the help of a theodolite. From these findings it appears that the Sanctuary Ocean count may be effective only to approximately four miles from shore, making site elevation less relevant to the count results.

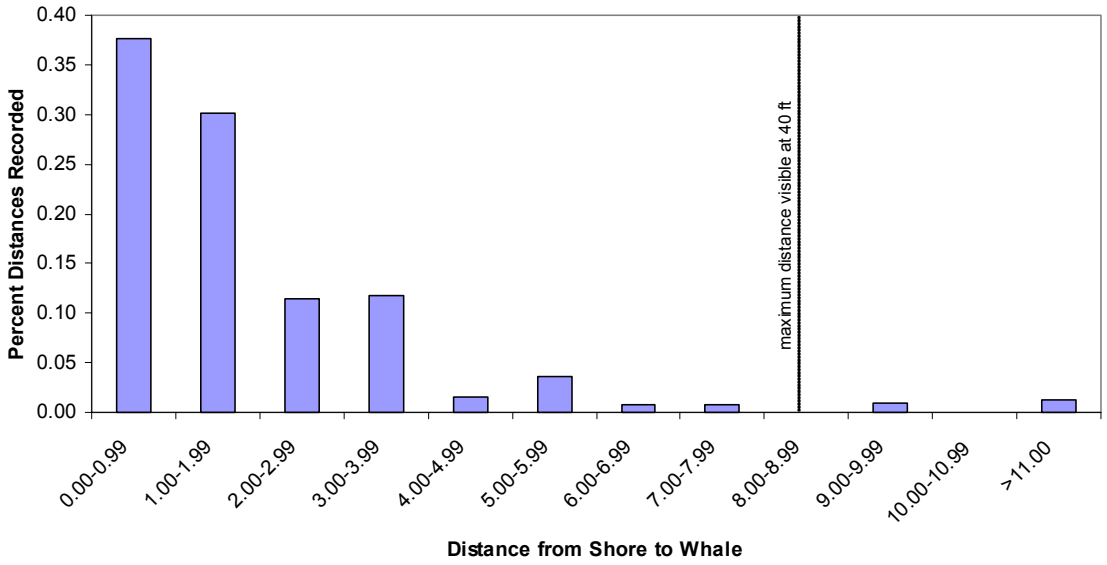


Figure 17 – Distribution of recorded shore-to-whale distances for Oahu, Hawaii and Kauai combined in 2003 expressed as percent total.

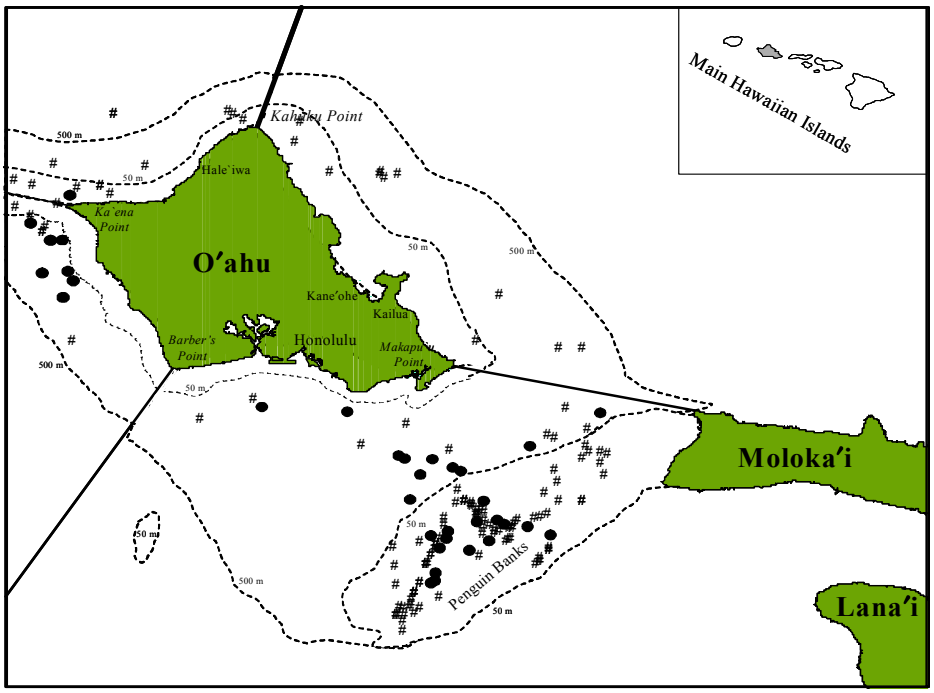


Figure 18 - Geographic location of humpback whale sightings recorded between July 1998 and June 2000 around the Island of O'ahu and Penguin Banks during opportunistic aerial surveys (from Maldini 2003).

BEHAVIORS

Humpback whales exhibit a wide range of behaviors, few of which are visible at the surface. The behavioral patterns chosen for monitoring were deemed representative of general activity states. Breaches and slaps are generally indicative of a high energy, socially active behavior. Fluke up dives are indicative of deeper diving patterns and are used during travel.

Behavioral data are intended to be collected over a long period of time, to determine the general use patterns of a particular site. Data over one single year may or may not be representative of the long-term use of a site. Behavioral data for 2003 were listed for each site in Appendix 1.

Data are expressed as number of events per whales (number of times the behavioral event occurred divided by the number of whales present), and averaged across months where repeated samples of the same location are available. More sophisticated analysis will be possible when a long-term database of behavioral activities will be available for each site. Therefore, the current analysis was not extensively interpreted.

In general, behavioral data quality was hard to control on O′ahu and Hawai′i partly because volunteers were trained by Site Leaders and the quality and amount of training may vary with Site Leader. It is clear, when looking at some of the datasheets, that the data collection procedures were, in many cases, not properly understood and/or followed.On Kauai, instead, all volunteers are trained by Sanctuary staff.

Although each site submit one or more behavioral datasheet, depending on the number of volunteers available, only one datasheet per site was used to calculate behavioral indexes. Data was only used if it was clear, collected according to procedure, and complete (no breaks in data collection). However, considerable variability in the number of whales spotted and in the number of behaviors tallied was evident at certain sites. If data collected were of comparable quality a datasheet was selected at random the same way a card is chosen from a deck.

For future surveys it is advisable to consider tightening quality control for this data or eliminating them from analysis.

SUMMARY OF RESULTS

1. In general all three islands had similar trends in the data.

2. There was no significant difference in abundance trends between 2002 and 2003.

3. Whales were more abundant in February for all three islands.

4. Whales were more abundant around Hawai’i.

5. Time of day (limited to morning observations) was not a significant factor for all three islands.

6. Site elevation was a factor in determining how far a whale could be seen and may have influenced the total number of whales counted at some site, but, overall, site elevation did not affect counts. Comparisons among sites were limited by this factor, which needs to be more appropriately addressed.

7. Coastline orientation appeared to be a factor in the differences in number of whales counted, but coastline preference changed with month and was not consistent among islands. More long term data are needed to address this question.

8. Variability of counts may also be due to changing weather conditions among and within sites. This variability was not taken into account.

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Mobley, J., S. Spitz, R. Grotefendt. 2001. Abundance of Humpback Whales in Hawaiian Waters: Results of 1993-2000 Aerial Surveys, Hawaiian Islands Humpback Whale National Marine Sanctuary, Office of National Marine Sanctuaries, National Oceanic and Athmospheric Administration, U.S. Department of Commerce, Department of Land and Natural Resources, State of Hawaii: 1-16.

SUMMARY OF RESULTS PER SITE

KO'OLINA (O'ahu)

BEHAVIOR

Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blow	Fluke Up	Year
0.10	*0.48*	-	*0.00*	2002
-	-	-	-	2003

February

Breach	Slap	Blow	Fluke Up	Year
0.41	*0.42*	-	*0.12*	2002
-	-	-	-	2003

March

Breach	Slap	Blow	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

MAILI POINT (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blow	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

February

Breach	Slap	Blow	Fluke Up	Year
0.14	*1.46*	-	*1.32*	2002
-	-	-	-	2003

March

Breach	Slap	Blow	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

The differences in observations in February between volunteers were large, giving poor credibility to the behavioral data collected.

MAKUA CAVE (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blow	Fluke Up	Year
-	-	-	-	2002
0.00	*0.29*	*5.14*	*0.21*	2003

February

Breach	Slap	Blow	Fluke Up	Year
1.03	*1.06*	-	*0.51*	2002
0.19	*0.38*	*0.75*	*0.31*	2003

March

Breach	Slap	Blow	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

KA'ENA POINT WEST SIDE (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blow	Fluke Up	Year
-	-	-	-	2002
0.00	*0.15*	*2.58*	*1.24*	2003

February

Breach	Slap	Blow	Fluke Up	Year
0.70	*0.80*	-	*0.49*	2002
0.00	*0.31*	*2.00*	*0.23*	2003

March

Breach	Slap	Blow	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

KA'ENA POINT NORTH SHORE (O'ahu)

BEHAVIOR

Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blow	Fluke Up	Year
0.23	*0.79*	*-*	*0.04*	2002
0.09	*0.00*	*1.64*	*0.12*	2003

February

Breach	Slap	Blow	Fluke Up	Year
0.47	*0.46*	*-*	*0.08*	2002
0.67	*0.00*	*0.50*	*0.00*	2003

March

Breach	Slap	Blow	Fluke Up	Year
-	*-*	*-*	*-*	2002
0.46	*0.54*	*4.16*	*0.03*	2003

MOKULE'IA (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blow	Fluke Up	Year
1.09	*0.30*	*-*	*0.65*	2002
-	*-*	*-*	*-*	2003

February

Breach	Slap	Blow	Fluke Up	Year
0.86	*0.01*	*-*	*0.00*	2002
0.64	*0.00*	*4.27*	*0.09*	2003

March

Breach	Slap	Blow	Fluke Up	Year
-	*-*	*-*	*-*	2002
0.69	*0.46*	*0.62*	*0.00*	2003

PUA'ENA POINT (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blow	Fluke Up	Year
0.19	*0.71*	-	*0.04*	2002
-	-	-	-	2003

February

Breach	Slap	Blow	Fluke Up	Year
0.63	*0.60*	-	*0.20*	2002
-	-	-	-	2003

March

Breach	Slap	Blow	Fluke Up	Year
2.14	*0.71*	-	*0.14*	2002
-	-	-	-	2003

SHARK'S COVE (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blow	Fluke Up	Year
0.31	*0.78*	*-*	*0.17*	2002
-	*-*	*-*	*-*	2003

February

Breach	Slap	Blow	Fluke Up	Year
0.00	*0.12*	*-*	*0.68*	2002
0.69	*0.10*	*1.82*	*0.13*	2003

March

Breach	Slap	Blow	Fluke Up	Year
0.13	*0.29*	*-*	*0.02*	2002
0.74	*0.46*	*2.08*	*0.05*	2003

TURTLE BAY (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blow	Fluke Up	Year
1.57	*0.68*	*-*	*0.00*	2002
-	*-*	*-*	*-*	2003

February

Breach	Slap	Blow	Fluke Up	Year
0.50	*0.28*	*-*	*0.26*	2002
0.00	*1.14*	*2.57*	*0.14*	2003

March

Breach	Slap	Blow	Fluke Up	Year
0.57	*0.29*	*-*	*0.00*	2002
-	*-*	*-*	*-*	2003

LA'IE POINT (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blow	Fluke Up	Year
0.00	*0.05*	*-*	*0.00*	2002
0.13	*1.17*	*0.83*	*0.65*	2003

February

Breach	Slap	Blow	Fluke Up	Year
0.10	*0.73*	*-*	*0.02*	2002
0.07	*0.28*	*1.07*	*0.05*	2003

March

Breach	Slap	Blow	Fluke Up	Year
0.45	*0.43*	*-*	*0.06*	2002
-	*-*	*-*	*-*	2003

HAU'ULA (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blow	Fluke Up	Year
-	-	-	-	2002
0.33	*0.67*	*0.83*	*0.00*	2003

February

Breach	Slap	Blow	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

March

Breach	Slap	Blow	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

KUALOA RANCH (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blow	Fluke Up	Year
0.38	*0.15*	-	*0.00*	2002
0.00	*0.67*	*0.56*	*0.11*	2003

February

Breach	Slap	Blow	Fluke Up	Year
0.93	*1.11*	-	-	2002
-	-	-	-	2003

March

Breach	Slap	Blow	Fluke Up	Year
0.00	*0.18*	-	-	2002
-	-	-	-	2003

PYRAMID ROCK (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.20	*0.13*	*-*	*0.20*	2002
_-	*-*	*-*	*-*	2003

February

Breach	Slap	Blows	Blows	Year
0.26	*0.13*	*-*	*0.16*	2002
0.00	*0.59*	*0.86*	*0.00*	2003

March

Breach	Slap	Blows	Blows	Year
0.02	*0.26*	*-*	*0.03*	2002
0.00	*0.08*	*1.03*	*0.00*	2003

MOKAPU POINT (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
0.00	*0.00*	*2.38*	*0.06*	2003

February

Breach	Slap	Blows	Blows	Year
0.45	*0.33*	-	*0.08*	2002
0.19	*1.02*	*5.90*	*0.00*	2003

March

Breach	Slap	Blows	Blows	Year
2.22	*2.59*	-	*0.00*	2002
0.15	*0.15*	*3.85*	*0.08*	2003

LANIKAI BEACH (O'ahu)

BEHAVIOR

Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
0.33	*0.78*	*6.83*	*0.11*	2003

March

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
0.11	*0.22*	*2.67*	*0.00*	2003

WAIMANALO (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.29	*0.09*	-	*0.04*	2002
-	-	-	-	2003

HALONA BLOWHOLE (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.10	*0.40*	*-*	*0.15*	2002
0.23	*0.77*	*2.13*	*0.23*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.34	*0.13*	*-*	*0.09*	2002
-	*-*	*-*	*-*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.17	*0.11*	*-*	*0.12*	2002
0.23	*1.75*	*2.23*	*0.00*	2003

MAKAPU'U POINT (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
0.13	*0.48*	*2.41*	*0.22*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.12	*0.23*	-	*0.10*	2002
1.72	*0.44*	*3.03*	*0.00*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.21	*0.50*	-	*0.36*	2002
0.48	*0.93*	*4.16*	*0.13*	2003

LANAI LOOKOUT (O'ahu)

BEHAVIOR

Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.53	*0.67*	*-*	*0.20*	2002
0.77	*0.27*	*1.82*	*0.32*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.38	*0.31*	*-*	*0.57*	2002
0.42	*0.05*	*3.79*	*0.47*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.17	*0.17*	*-*	*0.30*	2002
1.52	*1.26*	*2.71*	*0.13*	2003

HANAUMA BAY (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.20	*0.67*	*-*	*0.13*	2002
0.15	*0.08*	*2.00*	*0.08*	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	*-*	*-*	*-*	2002
0.05	*0.13*	*1.49*	*0.06*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.18	*0.09*	*-*	*0.14*	2002
0.51	*0.85*	*1.95*	*0.08*	2003

SPITTING CAVES (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
0.07	*0.07*	*1.17*	*0.30*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.26	*0.16*	-	*0.41*	2002
0.06	*0.14*	*3.86*	*0.66*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.00	*0.26*	-	*0.13*	2002
0.16	*1.26*	*3.39*	*0.35*	2003

DIAMOND HEAD (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
0.00	*0.00*	*1.33*	*0.00*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.49	*0.48*	-	*0.02*	2002
-	-	-	-	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.13	*0.00*	-	*0.13*	2002
-	-	-	-	2003

MAGIC ISLAND (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
1.19	*2.12*	*4.12*	*0.08*	2003

March

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

KAKAHAKO BEACH PARK (O'ahu)

BEHAVIOR

Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
0.32	*1.84*	*2.16*	*0.63*	2003

March

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

EWA BEACH (O'ahu)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

March

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

PUNALU'U BLACK SAND BEACH PARK (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

March

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

KA LAE BEACH PARK (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.05	*0.01*	*-*	*0.05*	2002
0.08	*0.99*	*2.99*	*0.00*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.06	*0.37*	*-*	*0.04*	2002
-	*-*	*-*	*-*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.04	*0.50*	*-*	*0.00*	2002
-	*-*	*-*	*-*	2003

HO'OKENA BEACH PARK (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
0.50	*1.00*	*6.50*	*0.00*	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
0.12	*0.27*	*5.08*	*1.04*	2003

March

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

HONAUNAU LOOKOUT (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.05	*0.35*	-	*0.30*	2002
0.00	*0.08*	*3.58*	*0.50*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.00	*0.25*	-	*0.00*	2002
-	-	-	-	2003

KEA'U HOU (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
1.41	*0.67*	*-*	*0.21*	2002
0.08	*0.99*	*2.99*	*0.00*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.07	*0.66*	*-*	*0.00*	2002
0.23	*0.10*	*3.70*	*0.53*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.00	*0.25*	*-*	*0.00*	2002
0.17	*0.50*	*2.83*	*0.17*	2003

KEAHOLE OTEC (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.40	*0.00*	*-*	*0.75*	2002
0.05	*0.31*	*4.15*	*0.25*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.22	*0.36*	*-*	*0.87*	2002
0.94	*0.66*	*4.69*	*0.06*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.40	*0.19*	*-*	*0.35*	2002
1.00	*0.80*	*5.00*	*0.00*	2003

HUALALAI (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.26	*0.27*	*-*	*0.66*	2002
0.16	*0.25*	*1.46*	*0.40*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.44-	*0.48*	*-*	*1.62*	2002
0.44	*0.21*	*1.12*	*0.35*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.15	*0.50*	*-*	*0.42*	2002
-	*-*	*-*	*-*	2003

MILE 7 MARKER (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.22	*0.36*	*-*	*0.38*	2002
0.20	*0.03*	*1.99*	*0.25*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.29	*0.21*	*-*	*0.29*	2002
0.21	*0.24*	*0.54*	*0.30*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.04	*0.17*	*-*	*0.38*	2002
0.14	*0.48*	*3.05*	*0.57*	2003

PU'UKOHOLA HEIAU (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.14	*0.76*	*-*	*0.30*	2002
0.36	*0.14*	*0.91*	*0.10*	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	*-*	*-*	*-*	2002
0.13	*0.15*	*0.93*	*0.00*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.07	*0.52*	*-*	*0.02*	2002
-	*-*	*-*	*-*	2003

LAPAKAHI STATE PARK (Big Island)

BEHAVIOR

Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.11	*0.45*	*-*	*0.25*	2002
0.02	*0.11*	*2.31*	*0.44*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.09	*0.46*	*-*	*0.21*	2002
0.69	*1.51*	*3.62*	*0.13*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.15	*0.72*	*-*	*0.47*	2002
0.06	*0.37*	*3.51*	*1.29*	2003

KAPA'A BEACH PARK (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
1.83	*0.90*	*-*	*0.43*	2002
0.09	*0.49*	*10.70*	*1.00*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.32	*0.27*	*-*	*0.46*	2002
1.19	*2.57*	*6.39*	*0.29*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.37	*0.56*	*-*	*0.59*	2002
0.08	*0.03*	*3.00*	*0.37*	2003

OLD COAST GUARD ROAD (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.99	*0.87*	-	*0.07*	2002
-	-	-	-	2003

March

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

UPOLU POINT (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.59	*0.51*	-	*0.09*	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
1.42	*2.27*	-	*1.27*	2002
4.39	*1.30*	*6.13*	*0.04*	2003

March

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

WAIPIO VALLEY LOOKOUT (Big Island)

BEHAVIOR

Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.00	*0.11*	*-*	*0.00*	2002
-	*-*	*-*	*-*	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	*-*	*-*	*-*	2002
1.29	*0.71*	*1.43*	*0.00*	2003

March

Breach	Slap	Blows	Fluke Up	Year
-	*-*	*-*	*-*	2002
1.20	*0.00*	*0.20*	*0.00*	2003

LAUPAHOEHOE SCENIC LOOKOUT (Big Island)

BEHAVIOR

Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
0.55	*0.27*	*4.06*	*0.03*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.67	*0.00*	-	*0.33*	2002
0.86	*0.86*	*2.36*	*0.00*	2003

ONEKAHAKAHA BEACH PARK (Big Island)

BEHAVIOR

Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
1.14	*0.14*	*-*	*0.03*	2002
-	*-*	*-*	*-*	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	*-*	*-*	*-*	2002
0.46	*0.14*	*1.21*	*0.04*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.66	*0.15*	*-*	*0.02*	2002
0.35	*0.57*	*2.48*	*0.09*	2003

KUMAKAHI LIGHTHOUSE (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.25	*0.00*	*-*	*2.63*	2002
0.00	*0.00*	*7.38*	*1.34*	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	*-*	*-*	*-*	2002
-	*-*	*-*	*-*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.18	*0.71*	*-*	*0.76*	2002
-	*-*	*-*	*-*	2003

KAHENA LOOKOUT (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.50	*0.00*	-	*0.25*	2002
-	-	-	-	2003

March

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
0.25	*0.00*	*0.63*	*0.13*	2003

KA'ENA POINT (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

March

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

PAUKA'A POINT (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.94	*5.20*	-	*0.30*	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.50	*5.20*	-	*0.30*	2002
-	-	-	-	2003

O'OKALA (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.10	*0.37*	-	*0.00*	2002
0.46	*0.14*	*1.21*	*0.04*	2003

March

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

ROYAL KONA (Big Island)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.13	*0.39*	-	*0.29*	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.30	*0.10*	-	*0.10*	2002
-	-	-	-	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.00	*0.00*	-	*0.00*	2002
-	-	-	-	2003

LUMAHAI LOOKOUT (Kauai)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
2.70	*0.10*	*-*	*0.00*	2002
-	*-*	*-*	*-*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.99	*0.65*	*-*	*0.17*	2002
3.46	*0.92*	*4.54*	*0.00*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.33	*1.00*	*-*	*0.00*	2002
-	*-*	*-*	*-*	2003

PRINCEVILLE (Kauai)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.75	*2.08*	*-*	*0.33*	2002
0.13	*0.25*	*2.63*	*0.00*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.44	*1.15*	*-*	*0.23*	2002
1.15	*0.48*	*1.70*	*0.00*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.46	*0.85*	*-*	*0.00*	2002
0.20	*0.80*	*1.90*	*0.20*	2003

KILAUEA LIGHTHOUSE (Kauai)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.63	*0.39*	*-*	*0.09*	2002
0.00	*0.75*	*2.00*	*0.00*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.16	*0.21*	*-*	*0.16*	2002
0.19	*0.27*	*3.50*	*0.00*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.02	*2.31*	*-*	*0.46*	2002
0.17	*0.25*	*1.58*	*0.00*	2003

CRATER HILL EAST (Kauai)

BEHAVIOR

Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.20	*0.25*	*-*	*0.00*	2002
0.54	*0.38*	*2.92*	*0.15*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.13	*0.13*	*-*	*0.06*	2002
0.11	*0.26*	*4.53*	*0.08*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.13	*0.00*	*-*	*0.19*	2002
0.25	*2.05*	*4.70*	*0.10*	2003

KAPA'A LOOKOUT (Kauai)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.60	*0.10*	*-*	*0.00*	2002
0.07	*0.40*	*4.35*	*0.00*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.07	*0.19*	*-*	*0.05*	2002
0.35	*0.82*	*2.93*	*0.03*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.17	*0.57*	*-*	*0.22*	2002
0.14	*0.79*	*1.36*	*0.00*	2003

AHUKINI LANDING (Kauai)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
0.20	*0.40*	*6.03*	*0.53*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.54	*0.57*	-	*0.57*	2002
0.13	*0.04*	*2.26*	*0.02*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.17	*0.57*	-	*0.22*	2002
0.04	*1.96*	*2.38*	*0.77*	2003

NININI POINT (Kauai)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.26	*0.21*	*-*	*0.11*	2002
0.00	*0.07*	*1.67*	*0.29*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.09	*0.68*	*-*	*0.23*	2002
0.37	*1.42*	*6.97*	*0.03*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.00	*0.16*	*-*	*0.65*	2002
0.06	*2.50*	*7.09*	*0.25*	2003

MAHAULEPU HAULA (Kauai)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.71	*0.20*	-	*0.03*	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.13	*0.19*	-	*0.14*	2002
-	-	-	-	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.02	*0.55*	-	*0.43*	2002
-	-	-	-	2003

MAHAULEPU MAKAWAHI (Kauai)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.50	*0.02*	*-*	*0.00*	2002
0.00	*0.00*	*1.57*	*0.23*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.13	*0.02*	*-*	*0.16*	2002
0.59	*0.62*	*5.95*	*0.00*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.66	*4.45*	*-*	*0.43*	2002
0.00	*0.00*	*1.46*	*0.46*	2003

MAKAHU'ENA (Kauai)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.59	*0.41*	*-*	*0.37*	2002
0.08	*1.27*	*6.23*	*0.11*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.15	*0.08*	*-*	*0.45*	2002
0.22	*0.22*	*2.32*	*0.13*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.64	*1.09*	*-*	*0.42*	2002
-	*-*	*-*	*-*	2003

PO'IPU BEACH PARK (Kauai)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.45	*0.88*	*-*	*0.16*	2002
0.12	*0.61*	*3.58*	*0.67*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.05	*0.05*	*-*	*0.23*	2002
0.13	*0.73*	*0.80*	*0.00*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.64	*1.09*	*-*	*0.42*	2002
0.00	*0.57*	*1.71*	*0.00*	2003

KA'IWA POINT (Kauai)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.13	*0.36*	*-*	*0.11*	2002
0.05	*1.38*	*1.73*	*0.34*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.06	*0.03*	*-*	*0.09*	2002
0.00	*0.00*	*2.33*	*0.42*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.03	*0.23*	*-*	*0.10*	2002
-	*-*	*-*	*-*	2003

PORT ALLEN CEMETERY (Kauai)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
0.13	*0.36*	*-*	*0.11*	2002
0.21	*1.24*	*4.98*	*0.60*	2003

February

Breach	Slap	Blows	Fluke Up	Year
0.06	*0.03*	*-*	*0.09*	2002
-	*-*	*-*	*-*	2003

March

Breach	Slap	Blows	Fluke Up	Year
0.03	*0.23*	*-*	*0.10*	2002
0.00	*0.97*	*1.73*	*0.00*	2003

WA'IMEA CANYON DRIVE (Kauai)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
0.00	*0.50*	*1.00*	*0.00*	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

March

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

KEKAHA (Kauai)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

March

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

PMRF (Kauai)

BEHAVIOR
Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

March

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
-	-	-	-	2003

KUIKUI POINT, KAHO'OLAWE

BEHAVIOR

Expressed as average number of behavioral events per whale present.

January

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
0.06	*0.42*	*3.06*	*0.72*	2003

February

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
1.32	*2.55*	*5.99*	*0.11*	2003

March

Breach	Slap	Blows	Fluke Up	Year
-	-	-	-	2002
1.20	*2.15*	*3.09*	*0.70*	2003